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GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

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VOL. CLXVI., No. 3179.] WEDNESDAY, APRIL 16, 1924. [76TH YEAR.

EDITORIAL NOTES.

The Approach of the Opening Day.

We are drawing near to the day of the opening, by His Majesty the King, of the British Empire Exhibition. The occasion will be one for all the pomp and circumstance of a State function. Nothing less would befit the inauguration of an exhibition which has been designed and organized, and given an appropriate setting, with the view of presenting to the whole world a picture in material form of the products, natural and manufactured, and the results of the genius, of the British Empire. The very thought of this should stimulate the pride of every patriotic individual in this country and in the Dominions and Colonies across the seas; and we have not the slightest doubt that it will do so. Everybody will want to visit the exhibition, though it will not be the good fortune of all who so desire to enjoy fulfilment. But no one who can possibly get there will miss it. For the men in the gas industry, there will be special opportunities to pay visits through meetings and conferences; but most gas men will be anxious to do at other times what other people will do—pay visits, and exercise their own bent of mind as to their itinerary, because there will be an almost overwhelming general interest in the show, which they will wish to inspect apart from the exhibits appertaining to the industry with which it is their honour to be associated and duty to serve, or those industries in which circumstances cause them to take more than a mere distant interest—such as the coal, chemical, electrical, oil, and mechanical and structural engineering. There will also be the representations of the life of the people in the eastern parts of the Empire; the arts and sciences of the Empire will be exemplified; and those who believe in mixing light recreation with their more serious interests will be able to gratify their desire in manner not always available. It will, in fine, be the concentration of a vast reaping throughout the Empire. From the moment of entrance to that of leaving, there will be no lack of enjoyment for both eye and mind; and the spending of several days at Wembley would not exhaust the interest.

There has been talk of the exhibition not being finished by the opening day. It will not be; but it will be well on the high road to consummation. When one comes to creations of the spaciousness of this one—the area covered, the enormous buildings (divided and sub-divided), the display scope of it all, the distances and diversity of places from which the mighty collection has been made, it is not surprising (apart from the unreasonable strike and the man-hours lost during nearly three days) that the opening day may find still some remaining scaffolding to be removed, levelling to be done, more packing cases to be relieved of their contents (which will have to be positioned), and some finishing touches to be applied to buildings, exhibits, &c. But things are here done in the mass. Time is multiplied by several thousands of hands, all skilled in different ways and degrees; and now many are there who are skilled not in building, but in the placing and running of machinery, in processes, and in the countless other things that will go to make complete this marvellous presentment of the glory and wealth of the Empire. The progress of all the work is such that the evening of each day finds transformation from the morning, and the following morning from the preceding evening. An exhibition of the kind is something that defies positive estimates. There can be calculation; and a plea to Providence that the result may be a justification of the sum. But we have a fair amount of confidence that those who measured the time required under given conditions will not find, making allowance for unfortunate and ungracious happenings, that their computations were very far out—the secret being that (with the close completion of the huge buildings) the exhibition is composed of almost countless sections; and to-day each section may be said to be in the hands of specialized men, each man or gang having his or their own "job" to perform and to complete as rapidly as possible.

Gas men will make the Gas Exhibit their first objective. That is only natural. For them it will be the centre of everything, together with the associated events. It will be, so to speak, their Wembley headquarters, their rendezvous, the place where information will be available. The men of the industry must not, however, expect too much of the attendants, whose main business will be to serve the industry among the visiting public. That is what the organizing Committee have been working for in this co-operative and co-ordinated Gas Exhibit—a Committee the members of which have, on behalf of the industry, thrown into the display much thought and energy. The constitution of the Committee is representative of the central organizations of the industry—the National Gas Council, the Institution of Gas Engineers, the "B.C.G.A.," the Gas Companies' Protection Association, and—last-named, but not least in importance—the Society of British Gas Industries. All have worked with a fine will—all with a determination that no effort on their part shall be wanting which would contribute to a finished success. There may be on the opening day a few things to remove connected with the preparatory work for the display; there may be traces of the last endeavours to get as near completion as possible by that date; there may be some finishing touches to be applied, and details to be carried out. But the Executive Committee will have nothing of which to be ashamed. The will to do has so far accomplished much; the next few days will see a big addition. We have previously given general indication of the character of the buildings and exhibit plans. That it will be a highly attractive display, and will prove to be magnetic, we may say is assured. The conception of its general features shows an appreciation of the tastes of the public, of modern requirements in respect of "drawing" power, of the manner to impress, which is not by overloading and nauseating by superabundance. Rational display and novel demonstration will do exactly the work that the gas industry has in view, and will do it well. Types, and not mass, are required in these times; action, and not inertness, is necessary; and something that will dwell particularly in the memory is, if not precisely an essential, of permanent value. These are the lines along which the Committee have obviously worked—and, in the event, all will say successfully—in the two main sections treating of the domestic and industrial applications of gas.

One of the chief features of the Domestic Section will be a series of living pictures, each in a model room, fitted with the latest gas appliances in actual working order. These will illustrate "The Seven Ages of Woman"—from infancy to old age. The organization of this feature has been entrusted entirely to Mrs. E. M. Wood, C.B.E., who presided over the Committee appointed by the Government to inquire into, and report upon, the problems of present-day domestic service. The mannequins will be chosen from trained ladies who have served in one capacity or another for several years in the various gas undertakings of the United Kingdom, and who will, therefore, while acting their several parts, be able to explain in the capacity of

children's nurse, college girl, business woman, or housewife, the cardinal fuel problems under each Age, and how gas can help in their solution. This practical feature will occupy the model rooms surrounding the central Rest Lounge in the Gas Exhibit. Printed programmes of the whole series will be available for visitors; and it is expected that in the cosy Lounge many a useful discussion will follow between groups of friends upon the new ideals of domestic economy, and the ways and means for reducing drudgery and adding to the leisure hours of women throughout the Seven Ages. In fact, by the end of the exhibition, it is not too much to say that the Seven Ages of Woman will be more familiar to the public than Shakespeare's famous Seven Ages of Man.

It is confidently expected that the great Exhibition will be productive of much good, through its material demonstration of the resources and capabilities of the Empire; and in that issue the gas industry throughout its component parts will have participation. An immediate full development of results there will not be; we do not wish for it. We would rather the Exhibition be, as it undoubtedly will be, evolutionary; that from it will steadily flow for many years to come an accretion to industrial and trade expansion, which will continuously carry with it all the energizing influences which come to a nation and its associates through progress and a gratifying prosperity.

Better Outlook in the Coal Industry.

Significant and gratifying is the result of the miners' ballot on the new wages offer of the coal-owners, made with the view to maintain peace in the industry, and to do as much as is reasonably possible to increase the earnings of the poorer-paid men of the industry, though all the workers would benefit under the scheme. The gratification experienced is due to the significance of the result, though it would have been far more gratifying had the small majority in favour of rejection been transferred to the side of the large number of men who were in favour of accepting the owners' offer. The majority against acceptance was only 16,258 out of a total vote of 661,042, which means that 338,650 were for rejection and 322,392 for acceptance. The total number of men and boys employed at the collieries is 1,188,500, and the number of members of the Miners' Federation is 768,060, so of the latter there were 107,018 members who did not vote. These figures constitute one of the points which we regard as highly significant. They show that those who actually voted in favour of rejection represent only about 44 p.ct. of the membership of the Federation, and only between 28 and 29 p.ct. of the total number of workers in the industry. Probably some members of the Federation who were passive would, had they exercised their right, have voted in favour of rejection; but the fact that they were passive does not indicate any strong feeling of antagonism to the owners' offer. These are generally the class of men who would prefer to be left undisturbed.

The next significant point is that at the delegate conference at which the resolution was carried to take a ballot of the men on the offer and to recommend its rejection, the voting was 502,000 in favour of non-acceptance, against 271,000 for acceptance. This shows that the delegates at the conference did not represent the views of the men as to the value of the owners' revised suggestions, and that they positively misconceived what those views were likely to be. The voting of the men, though a trifle on the delegates' side, is a definite declaration that the voting at the delegates' conference was more a matter of personal inclination than something based upon knowledge of the opinions of the men themselves. The result of the ballot is, in short, rather a nasty rebuff for the delegates, and for their deliberate attempt to guide the ballot in the direction in which they desired it to go by recommending, on the voting papers, refusal of the owners' offer. There is a decided indication here, and in the recommendations of certain local leaders, of a strong current of feeling in the districts that the men are not all disposed to be bridled from headquarters. The extremists in the Federation and the delegates will probably take the hint, and trim their sails accordingly. The owners will also feel that the ballot has strengthened their hands, as it indicates that nearly half of those who voted recognize that the owners have tried to effect a reasonable settlement, and that these men prefer, when this is obvious, a peaceful existence rather than a continuance of turbulence when there is no occasion for it. The owners also know full well that many who voted for rejection did not do so on the merits of the offer, but because of the direction received on the ballot-paper.

The next significant point is equally satisfactory, especially to large users of coal such as the gas industry. The result of the ballot is as much an instruction to the Miners' Federation to persevere in finding a way out of the difficulty as it is to follow the path which would lead to the taking of a strike ballot to ascertain whether the men desire to plunge the country into further disorder, and themselves and their families into a state of precariousness and misery. The ballot has not strengthened the hands of either the Federation or the delegates; and there is good confidence that they would hesitate now, with the ballot result confronting them, to proceed with a strike ballot, inasmuch as for it to be effective there would have to be a two-to-one majority, or 512,040 votes against 256,020 if all the members of the Federation could be induced to cast their votes. The possibility of this now looks very remote; moreover, the men in certain districts know full well that their unions have not recovered sufficiently financially to bear for any length of time the burden of adequate strike pay for the workers in the industry. Anyway, there will be no immediate strike. The notice for terminating the present national agreement expires to-morrow; and it is understood that the owners and the representatives of the men will be meeting to-day to consider the terms on which work shall be continued after April 17, pending the report of the Court of Inquiry which the Labour Minister promptly decided to set-up, to investigate the questions involved in the dispute, when he learned that the latest offer of the owners had been rejected. The small balance in favour of rejection will no doubt cause the Court very carefully to scrutinize the terms of the offer, to ascertain whether there are sufficient causes remaining for a dispute.

Corrosion of Gasholders.

This is a question which is ever with the gas engineer. But it has been raised more frequently of recent years than formerly. The reason for this is the very good one that the experience of engineers is that corrosion nowadays is proceeding more rapidly than was at one time the case. Some engineers attribute this to the alteration in the composition of gas; others to the change from wrought-iron plates to mild steel ones. Others, again, disregarding these matters, are searching around for the best coating to apply to holders inside and out in order to give them longer life through greater protection from the attacks of corrosion. This last aspect of the matter was raised during the discussion, at the North British Association meeting, on the paper by Mr. Laurence R. Hislop, in which he described his new spiral-guided holder with ferro-concrete tank. It was Mr. David Vass who started the subject of obtaining a preservative which would keep a holder free from oxidation. He pointed to what is rather an interesting fact. Going into a holder which was being dismantled, he noticed that the only signs of paint which had been preserved on the inside were the white-lead paint markings of the makers of the sheets. He inferred from this that white-lead paint was a better preservative than red-oxide paint or any other preparation gas engineers are in the habit of using. Mr. Hislop tried to obtain other experience as to white-lead paint, but none was forthcoming. More than one speaker referred to graphite paint as being very good. From a long experience of holder work, Mr. J. W. Scott, of Manchester, prefers red-lead paint; but he, too, had to confess that he could offer no "conscientious expression of opinion" as to which paint is the best. This, we think, is the general feeling; and it supports the view of some of those present at the meeting that the question of a trusty preservative to use —internally and externally—on holder sheets is a matter which requires thorough investigation. The greater the rapidity of corrosion, the greater the speed of the destruction of part of the capital represented by the holder, and the more frequent the cost of repairs. Therefore, if investigation can bring about the provision of a better preservative, it would be an economy of considerable value to the gas industry.

In regard to the sheeting of gasholders, it will be remembered that Mr. R. J. Milbourne and Mr. Samuel Cutler, both gasholder constructors of large experience, at the last meeting of the Society of British Gas Industries, spoke of the more rapid deterioration of mild-steel sheeting compared with the wrought-iron sheeting of former days, which latter

under present gas-works conditions is not affected so quickly or so much as the former. They mentioned examples which showed that wrought-iron sheeting for gasholders has twice the longevity of the mild-steel variety. They, too, asked for research into the relative merits of wrought iron, mild steel, and Armco iron sheets. Naturally, the builders of gasholders are as anxious as gas engineers that their work shall have good life. Reputations are made through the giving of satisfaction; and the more rapid deterioration of holders in these days does not tend to the promotion of satisfaction. There are thus two lines of investigation suggested in connection with gasholders—one into the material for their sheeting, and the other into the question of the best preservative to apply both internally and externally.

It is interesting to note that this question of the more rapid corrosion of gasholders is not confined to this country. We remember that some time ago Mr. Philip C. Holmes Hunt raised it in a Presidential Address in Australia; and at the last annual meeting of the New England Association of Gas Engineers, it was introduced in a paper by Mr. C. A. Schnerr. We reproduce this contribution in the "JOURNAL" this week, though it treats more of chemical causes (about which a good deal is known) than with remedial measures or preservatives. The view of Mr. Schnerr is that the causes should be attacked. The paper, however, does not go far in providing constructive remedy, and that is the direction in which knowledge is required.

Where are our Consulting Gas Engineers?

MORE than once we have complained of the ignoring of the gas industry in connection with the appointment of committes who are considering matters in which the industry is concerned. The Institution of Civil Engineers have been guilty of this—we seem to remember—on more than one occasion. The last occasion on which we referred to their slighting of the gas profession was on March 19 [p. 691], in respect of the Committee appointed to consider matters associated with internal combustion engines. When reconstruction was at fever heat, and the question of the power requirements of the country was thought to be a matter for urgent consideration, the investigation was placed by a Government Department under the control of electrical men, and a fine mess has been the result. When the World Power Conference at the British Empire Exhibition was being organized, the gas industry was left out in the cold in respect of representation until (we think it was Sir Arthur Duckham who first stirred-up the matter) movement was made to obtain recognition, and this had a favourable issue. Another point comes to notice as we study the exhibition. It seems, from what we learn, that the appointments of consulting engineers in directions in which the gas industry is concerned have been given to electrical men. We know the consulting engineers of the gas industry are very peaceful-going and reserved. They are to be found if wanted. Their office addresses can be traced by reference to Kelly, or their telephone numbers by investigating the mighty tome issued by the telephone department. But they do not seek a place in the limelight; and therefore they are more or less negligible quantities in public affairs. When consulting engineers are required in connection with gas undertakings, they are sought out, choice made, and the work for which their assistance is required is effected without fuss, and with that honesty of purpose which has always characterized consulting gas engineers. But in connection with public matters, their assistance appears never to be sought or needed. Why this should be is an enigma we shall not attempt to solve. Nevertheless, it is true. It is so in connection with the British Empire and other large exhibitions.

There are many miles of gas-mains at the British Empire Exhibition. Several exhibitors require gas. The gas exhibit will need a large quantity; so will Messrs. Lyons & Co., so will the lighting of the Amusements Park, and numerous processes and mechanical operations will seek its aid. A consulting gas engineer should have had supervision of all this, and have looked after the general interests of the gas industry in the formulating of the plans for the exhibition. Perhaps it is a compliment to the Brentford Gas Company and to the central organizations of the gas industry, who have been in close co-operation with the exhibition authorities through the Gas Exhibit Committee. But it is a doubtful compliment, when it is found that Messrs. Sparks & Co. are the Consulting Engineers for the lighting of the exhibition, and Messrs. Albion T. Snell and Partner are the consulting lighting firm for the Amusements Company. True, the outdoor lighting of the Amusements Park has been given to gas, but that is all. Precisely the same thing occurs at Olympia. There are always consulting electrical engineers; but never consulting gas men. The result is that any gas used in these exhibitions comes not as a matter of course, but in spite of, or by way of concession from, our electrical competitors. This is a matter that requires looking into and following up. We do not ask for any special privilege, but at any rate a public service industry such as that of gas supply ought to have an equality with the electrical industry in advisory and executive offices in organized public effort. So long as it has not that equality, so long will the strings be pulled in favour of the electricity industry. There is no reason whatever why the gas industry should be placed, in such matters as those to which we have alluded, in a subordinate position to the electricity supply industry. In other directions of public service, the gas industry is in the premier position. Then what is the reason there is not due and full recognition of this? Is there more personal pushfulness in the electricity industry? Anyway, in the organization of the British Empire Exhibition, electricity has a recognized place and voice through the appointment of consulting electrical engineers; but though gas is so much wanted and will be used, it has not had the same official place and voice in the work of organization.

Electrical Company Prospectuses.

Large numbers of gas shareholders have received prospectuses regarding capital issues of small electrical undertakings with inflated titles, capital, and promises. In certain of these, the Electrical Finance and Distribution Corporation, Ltd., have been concerned; and this Corporation has a close connection with the names of Eaton and others. This will be seen by various references in our "Electricity Supply Memoranda," and in the article "Pastures New" which appeared in the "JOURNAL" last week [p. 101]. Now it seems from a communication received by us from Mr. Albert E. Martin, the Secretary of the Merthyr Tydfil Gas Company, that the Electrical Finance Corporation are endeavouring to extend their resources and obtain new operating areas by securing additional names of investors in gas undertakings—obviously with a view to circularizing and attempting to induce them to invest in some of their precious promotions. The Corporation sent this letter to the Merthyr Tydfil Company, and no doubt many others have received copies:

> We are compiling a Special Register of Investors in Gas and Water Undertakings for the use of Companies desiring to increase their present, or issue fresh, capital.
>
> Your Company has not yet been included; and we should esteem it a favour if you would compile for us a copy of your Register of Members—names and addresses only; no holdings.
>
> On hearing from you, we shall be pleased to draw a cheque to defray your expenses in the matter.
>
> Your kind attention will oblige.

There will be no need for the Corporation to draw a cheque so far as Merthyr Tydfil is concerned; for, in Mr. Martin's opinion, the kindest attention he could give to the request of the Corporation was to ignore it. He hopes—and it is a hope we share—that in no instance will the names of shareholders be sent in response to the communication. The waste-paper basket is a suitable receptacle for such circular-letters.

Coal Demand and Supply.

The continued shortage of coal in the open market and for retail supplies shows that output and demand have passed the equilibrium point. Perhaps the condition has been accentuated by the rush of industries to obtain large stocks in view of the possibility of a strike. Such an eventuality does not to-day, as pointed out in an editorial article this week, appear so imminent as a week or two ago. But anyway the fact that there is a shortage of supplies through the strength of demand, and that output is at no better level than twelve months ago, must cause an amount of speculation as to what will happen when there is such a revival of trade and industrial activity that demand—home and export combined—is in excess of the output. The

Sankey Commission's production predictions have all gone astray; and the seven-hour day has not been so generous in its yield as the eight-hour one.

Safeguarding Duties to Lapse.

The Government who, being a Labour one, should be most solicitous regarding the protection and expansion of home employment, have decided not to introduce legislation to extend the duration of the provisions of Part 2 of the Safeguarding of Industries Act. The provisions, and the duties imposed under them, will accordingly lapse on Aug. 19. Two Orders have been made under Part 2; and in each case the duties imposed were 33⅓ p.ct. on the value of the goods imported. The first Order was made on Aug. 8, 1922; and among the goods embraced was glassware for use with artificial light, not including electric lamp bulbs, miners' lamp glasses, or oil-lamp chimneys. The second Order was made on Oct. 9, 1922; and this related to mantles for incandescent lighting, and component parts thereof, whether finished or not. The industries concerned regard the coming extinction of the safeguards with ardent dissatisfaction.

Summer Time.

Summer time commenced last Sunday morning. Very wintry conditions prevailed while the House of Commons last Friday discussed Sir Kingsley Wood's measure for spreading summer time over twenty-six weeks, commencing with the first Sunday in April and finishing on the first Sunday in October. There were the usual objections; but the Government were favourable, and the Bill was read a second time. If the measure passes, it will give effect to the recommendations on the subject of a conference of delegates representing Great Britain, France, Belgium, and Holland.

Wintry Weather and Gas Consumption.

The prolongation of wintry weather well into April has, we learn, made a large difference to the sales of gas of certain undertakings; and their experience of heavy increases is no doubt fairly universal. Wintry conditions have continued longer than normally they should have done; but should the prophets be correct as to a hot summer coming, the accrued increase of gas consumption will help to balance the diminution which a long high-temperature summer would no doubt occasion.

Deficits of Scottish Electricity Concerns.

A movement is now being made, through the National Gas Council, to investigate the question of securing the amendment of the Electric Lighting (Scotland) Act, 1890. This is the Act which inequitably enables Scottish municipal authorities owning gas and electricity undertakings to make the former responsible for liquidating the deficits arising from the working of the latter. In the autumn of last year, we commented two or three times upon what we regard as the scandalous situation which has arisen in Alloa through the existence of this power. The initial action proposed will be gathered from the minutes of the Central Executive Board of the National Gas Council, as published in a later column this week.

World Power Conference.

In the "Journal" for April 2 (p. 36), we published a provisional programme for the Gas and Fuel Section of the First World Power Conference at Wembley, which is to be held from June 30 to July 12. That, of course, is the section in which readers of the "Journal" will be chiefly concerned. Regarding the conference generally, this will be the first time that experts from practically every civilized country will assemble to contribute the results of their special knowledge to a common stock available for everyone. The Conference has been inaugurated by a British Executive Committee, acting under the auspices of a Grand Council, with the Earl of Derby as President, and composed of representatives of practically every Government Department, and of many of the chief figures in the world of research, technology, and industry. Invitations to participate have been accepted by twenty countries, which have formed National Committees. Briefly stated, this is an endeavour to consider how the industrial and scientific sources of power may be adjusted, nationally and internationally. The Conference will discuss potential world resources in hydro-electric power, oil, and minerals. It will compare experiences tendered by engineers, technical experts, and research authorities, who will be brought into touch with representatives of the world's leading consumers of power, and manufacturers of the instruments of production. The delegates will review educational methods in different countries, consider means by which existing facilities may be improved, and discuss financial and economic aspects. Finally, they will debate the possibility of establishing a permanent world bureau for the collection of data, the preparation of inventories of the world's resources, and the methodical exchange of industrial and scientific information, and appointing representatives in all countries. It is felt that this comparison of experience and methods, and exchange of opinions as to future steps to be taken, will result in further simplifying both production and application, so cheapening energy and increasing and extending its use.

Strikes and Lock-Outs.

The Government have not had a happy time since their advent to office. Things have gone very crooked in the industrial world through labour disputes, unauthorized strikes, and in London public inconvenience owing to interruptions of usual means of transport, and threats to intensify the inconvenience. What is more, the Government do not appear to know what to do. They are, in fact, on the horns of a dilemma. They do not want to do anything which would foil and offend their trade union friends; and yet they are not unmindful of the fact that all sections of the community have a right to the protection of the Government. The difficulty they are in is shown by references to these matters in the House of Commons, and by the discussion n the House of Lords of Lord Askwith's Bill on the occasion of its second reading. This measure is not to prevent strikes and lock-outs. Its intention is, when the Minister of Labour has referred a trade dispute to a court of inquiry, to make it unlawful, prior to the report being presented to the Minister, for any employer to declare or cause a lock-out or for any workman to go on strike on account of such dispute; but after thirty days from the date of reference to the court of inquiry, there is to be no bar to either party to proceed with a lock-out or a strike. The trade unions should welcome such proposals in these days of unauthorized strikes, and the engineering of more and more strikes to interfere with the convenience of the community. The Lord Chancellor told the House of Lords that he could hold out no hope that the Government would regard Lord Askwith's scheme with favour; but the Government decline to give any intimation of a policy of their own for dealing with this serious problem. We are afraid the truth of the matter is that the Government are not strong enough to govern on behalf of the nation where trade union interests are concerned. A Government who want to settle international disputes without war should be, as Viscount Cecil says, equally eager to settle industrial disputes without strife. However, Lord Askwith's Bill has been read a second time by the Lords.

London Traffic Bill.

The Standing Committee of the House of Commons who are dealing with this Bill have refused to grant the Minister of Transport control over a radius of 25 miles from Charing Cross, and have confined his activities to the City of London and the Metropolitan Police area, but at a later stage this may be expanded by the addition of certain districts.

PERSONAL.

Mr. E. Stamp, who has long been Birmingham Manager for Messrs. Glover & Main (B'ham), Ltd., has now also been appointed Sales Representative for the Midland District by Messrs. R. & A. Main, Ltd., whose distributing centre is at Gothic Works, King Edward's Road, Birmingham.

For fifty years Mr. George Pedder, Tax Collector and Clerk to the Westgate Parish Council, has been an employee of the Westgate and Birchington Gas Company, including a period as Manager. A complimentary supper took place last Saturday week at Birchington, at which his jubilee of service was celebrated. Mr. Cockburn (Secretary of the Company) presided, and it was a matter of general satisfaction and pride to those present that Mr. Tom Horton, another veteran servant of the Company, whose long service was commemorated at a similar function last year, was in support of the chair. Replying to the toast of the evening, Mr. Pedder told some interesting tales of his early experiences

with the Company—mentioning a narrow escape from drowning in the gasholder tank, when knocked off a raft by a strut while looking for a leak.

Mr. W. Morrison has been appointed to take charge of Gothic Works, King Edward's Road, Birmingham, where Messrs. R. & A. Main's new distributing centre for the Midlands will in future be located. His intimate knowledge of gas-stove construction will here be of great value, in view of the rapid growth of the firm's trade in that district.

Alderman Henry Wade Deacon, J.P., the Chairman of the Liverpool Gas Company, and this year's President of the British Commercial Gas Association, was presented with a silver loving cup at a luncheon at Park Hotel, Preston, last Thursday, by members of the Finance Committee of the Lancashire County Council, Chairmen of various standing joint committees, and county officials, in commemoration of his being elected Chairman of the Finance Committee 21 consecutive times. The presentation was made by Alderman Ralph Hassleton, and the health of Mr. Wade Deacon was toasted with musical honours.

Mr. R. Scott, who is well known in the gas industry in the Midlands, has been appointed Sales Representative in that district by Messrs. Thomas Glover & Co., Ltd., and will work in connection with the firm's Birmingham meter works in King Edward's Road.

The marriage took place on Saturday, the 12th inst., at St. Michael's Church, Sutton Court, Chiswick, of the only daughter of Mr. John MacKenzie, the Southern Representative of Messrs. Sawer and Purves, Meter Manufacturers, of Manchester, London and Nottingham; the bridegroom being Mr. Walter Martin, of Woolwich. A reception was afterwards held at the Clarendon Restaurant, Hammersmith Broadway, at which many friends were present. The honeymoon is being spent in the Isle of Wight.

On the occasion of his retirement on Friday last, Mr. G. W. Spencer, who has been Chief Clerk of the Sheffield Gas Company for over 47 years, was presented with a gold watch, subscribed for by the employees. Mr. T. Colland, who has been with the Company for more than half-a-century, in handing over the gift, paid high tribute to the character of Mr. Spencer, and the esteem with which he was regarded by the workmen.

ELECTRICITY SUPPLY MEMORANDA.

The electricity industry is looking forward with great expectations to the boosting effects of the British Empire Exhibition at Wembley. At any rate, it is hoping most sincerely and confidently that it will share in the great harvest which should result from the wonderful display. But that harvest is not something that is likely immediately to accrue in bulk; there will be a progressive influence upon industry and trade flowing from the Exhibition for many years to come. One of our electrical contemporaries records that the electrical section in the Palace of Engineering is rapidly nearing completion, and that the exhibit organized by the Electrical Development Association, on behalf of the supply industry, is to all intents and purposes finished. It is remarked that in these respects the industry is well ahead of others; and it is piously hoped that it will continue ahead throughout the Exhibition. We have no doubt there is a fervent desire that the portion of the harvest to be reaped by the industry will be above that of all others. No one, of course, can say. "The Electrician" seems to think that Wembley will be dominated by electricity, and that it will be advertising itself not only in the highways, but in the by-ways and nooks and crannies of the whole show. Of course, this is not the case, though admittedly electricity will have a large representation, but the many miles of gas-pipes have not been laid through the Exhibition for the mere pleasure of having them underground. Naturally, the public will be more attracted by the Electrical Development Association's display of the applications of electricity than by the larger machinery and goods which represent generation and distribution. But in connection with these, it is pointed out by one writer that it will be found that British equipment has nothing whatever to fear from exotic productions. Although associated with the gas industry, we are proud of the fact. We do not want to see foreign superiority over any of our manufactures. At the present time, they may have a superiority in respect of lowness of price; but it does not follow that it is wise to buy machinery on price alone, without regard to material, structural quality, and operating efficiency. But in respect of electrical applications, we are told, in an article in our contemporary, by Mr. S. E. Britton, the President of the Incorporated Municipal Electrical Association, that the display which will be made by the Development Association will be a most impressive one. We are glad of that, and we have some assurance in saying that the Gas Exhibit will likewise be of an impressive character, though it is impossible for the gas industry to take into the Exhibition examples of the manufacturing plant of great magnitude which supplies gas to the major part of the population of Great Britain. But we think Mr. Britton shows a little selfishness when he suggests "that the time has arrived to open a campaign having for its object the making of electricity the universal provider of comfort, convenience, and economy in our industries and homes." We think there is so much room in this country for both the gas and electricity industries that he might allow the former to continue to have a sufficient amount of the business that is going to maintain it in a fairly comfortable condition. A few figures which Mr. Britton gives are of interest. He states that there are in Great Britain 1126 urban districts, with a population amounting to 30,000,000, and 672 rural districts with a population of 7,850,000. There are 544 electricity supply authorities, which during 1923 generated 5,421,000,000 kw.-hours; the *per capita* consumption being 143 kw.-hours for the year, as compared with an estimate of 470 kw.-hours in the United States.

B.E.E. Expectations.

Gas for Catering at the B.E.E.

Some of the electricity people are green with envy over the fact that such a great firm of caterers as Messrs. Lyons & Co. should have selected gas as cooking agent for the immense amount of catering they will have to negotiate at the British Empire Exhibition. Messrs. Lyons know their business well; but "Meteor" of the "Electrical Times" apparently has greater knowledge of it than they. He quotes this passage from a newspaper: "While gas and electricity are friendly competitors, each having its own special sphere of action, as a fuel gas holds premier place." He says this is offered as a logical deduction of the fact that Lyons's cooking at the exhibition will actually be done by gas. "In reality," he adds, "no such deduction can be justified. The story is a long and complex one; and the caterers seem to have been guided by many factors of precedent, policy, and hand-to-mouth expediency." We are altogether oblivious as to the meaning "Meteor" wishes his readers to give to these words, and we expect other people are also. Without question, policy, expediency, and an unrivalled experience in catering work did influence decision. He goes on to say that "mere thermal efficiencies did not decide the case at all." There again we have not the slightest doubt that he is right. We should imagine that economy, expedition, and reliability were factors which lent weight to the decision. Fancy Messrs. Lyons with the responsibility upon them of a multitude of people to feed trusting to such a capricious agent as electricity. However, the omniscient "Meteor" asserts that, if thermal efficiencies had determined the matter, the cooking would have been electrical. He does not indicate why; as a matter of fact, he leaves very much to the imagination of his readers. However, he thinks it a thousand pities the gas propagandists should be able to call attention to these assertions; but, from what he says, the electrical people did their best to prevent the gas propagandists having the honour of being able to note the preference of such catering experts as Messrs. Lyons. It is stated that, from the beginning, the electrical people "certainly left nothing undone to render the Wembley restaurants all-electric." Nevertheless, the important work will be done in the kitchens at Wembley by gas. Fortunately, says "Meteor," there will be plenty of electric cookers and cooking on view—not in the Lyons restaurants.

Springtime.

Springtime offers opportunities for new business in labour-saving methods. Then house cleaning and renovation are in full swing; and at the present time there is now more removal work going on than has been the case during the past few years. It is an opportunity for running new piping, and fixing new gas appliances. There are lighting fittings to be modernized, gas cookers and fires to be installed, and water-heaters to be connected. Householders may not regard the spring as a good time for putting in gas-fires, but there are sound arguments in favour of it, as "Megohm" in the "Electrical Times" sees, save that he looks at the matter from the electrical point of view. When the housewife has done her spring cleaning, she does not wish to revert to coal fires, with all their dirt accompaniments. Therefore, as evenings and mornings are chilly, our friend thinks a few electric radiators would be a good thing; we are of opinion that gas-fires would serve the purpose better, and more economically. Dear and scarce coal stocks are another reason for pressing labour-saving heaters upon the attention of householders. But, according to "Megohm," contractors for electric radiators appear to live from hand to mouth; and so at this time of the year they have no stock of electric fires in hand with which to take advantage of springtime demand.

Troubles in Hospitals and Elsewhere.

The danger of relying upon electricity in the operating rooms of hospitals is again illustrated by the death, at Isleworth Infirmary, of Martha Selina Dewland, aged 63. She was admitted to the infirmary on April 2, and an immediate operation was necessary. While this was in progress, the electric light failed, and the operation had to be continued and concluded by candle light. According to Dr. Cook, the patient failed to come out of the anæsthetic owing to the time being prolonged through the failure of the light. This, it appears, was due to the breaking of two cables in the main road following a subsidence arising from heavy traffic. Death by misadventure was the verdict. There ought to be some means of protecting those undergoing operations against failures of the electric light. In the operating theatres of hospitals, it would be as well to have a dual system of lighting, if electricity is the agent preferred. To rely upon candles as a stand-by for such critical and vital work, ought to be regarded as negligence on the part of hospital

authorities. The authorities at Grimsby Hospital have had experience of the failure of the electric light during an operation; and they are proposing to protect patients by arranging for the surgeons to wear electric lamps on their foreheads supplied from independent batteries. We read of the electric light failing at a Dundee temperance conference; also during the rendering by an amateur company of "H.M.S. Pinafore" at Broughty Ferry; and among other recent incidents are breakdowns of supply at Woolwich and Wallasey. Last week there was considerable interruption of traffic on the Central London Railway owing to a fire which had electrical origin. From similar cause, a small fire occurred on an Ealing train at Mansion House Station, and current trouble caused a suspension of traffic between that station and Aldgate.

Wiring in a Corrosive Atmosphere.

There has been some interesting correspondence on this subject in the "Electrical Review;" and there is interest in it for gas-works engineers. Much trouble has been experienced with electric wiring in the corrosive atmospheres of chemical works; and the responsible officials have for a long time been looking out for a method of wiring which will ward-off the destructive influences of the gases and vapours met with. Now they are promised happiness through the coming of the ebonite-sheathed cable made by the Helsby Company, which it is asserted will stand well in the worst conditions for a matter of twenty years. In connection with the system, the boxes are said to be corrosion proof, and fume and water tight.

Repairing Appliances.

A highly interesting article recently appeared in the "Electrical Times," headed "Repair Shop Notes." We have often pointed out—not from mere surmise, but from information received as to actual payments—that the maintenance of electrical appliances is really no light affair; and this is a charge upon the consumers. In the article referred to, the admission is made that the cost of repairs gives rise to almost endless complaint. For example, the repairing of some appliances in an adequate manner—particularly certain of the cheap continental productions—costs, due to inaccessible construction, more than the appliances when new. Then another reason given for repair charges being sometimes high is that, whereas the original element may be of cheap materials and construction, the best quality materials only are used in making repairs. We are not surprised to learn that of all the appliances which pass through the repairer's hands, kettles are the most numerous. This it is blandly said is not to be attributed to any inherent weakness, but is due to the fact that kettles are more widely used than any other appliance, except electric irons. But it is declared that most of the failures result from misuse. There is, for example, a large number of breakdowns owing to appliances being allowed to boil dry; and it is suggested that this emphasizes the need for automatic protective devices. If we had said in the "Memoranda" half as much as is confessed in this article as to the inherent mechanical weaknesses of electric appliances, we should have been told we did not know what we were talking about, and that prejudice was at the root of our defamatory statements. We are not in the habit of criticizing in any way the appliances of our competitors without good ground and authority.

Apparatus Production below Capacity.

During their existence, the Electricity Commissioners have made large grants of loans for new work; but so far the loans do not appear to have done much to stimulate the electrical manufacturing trade in this country. This may be gathered from the address of Major-General Sir Philip A. M. Nash, K.C.M.G., to the shareholders at the meeting last week of the Metropolitan-Vickers Electrical Company, Ltd., from which it would appear that the potential manufacturing capacity of the electrical apparatus works in this country is far from being fully utilized, and there is little chance that it will be until the financial conditions abroad and easier costs in this country put our home manufacturers into a better competitive position with producers in other countries. The latter can produce and sell not only in our export markets, but here, at a price which would be totally unremunerative for our manufacturers in view of the costs of material and labour. As Sir Philip says, the year 1923 was one of great difficulty for the electrical industry. The manufacturing capacity for electrical apparatus in the country was considerably augmented for production purposes during the war; and now it is considerably in excess of that which existed in 1914, with the result that the volume of work placed in 1922 and 1923 was wholly insufficient to give normal utilization to that capacity. It follows that, while the electrical industry did not suffer from the general depression in trade as severely or as early as other important industries, it was inevitable that a time would come when it would have to experience the same slump as other industries on which it depends for a considerable amount of business. This time, Sir Philip points out, arrived in 1923; and it was particularly noticeable in the smaller types of apparatus, the demand for which affords a good barometer of trade. But there has been a brightening-up this year. In the aggregate a higher percentage of the Company's productive capacity is being utilized to-day than at any time during 1923. Altogether, Sir Philip is of opinion that the prospects are good for an increased output. They would be much better if the costs of production were lower.

NATIONAL GAS COUNCIL.

Central Executive Board.

The Central Executive Board of the National Gas Council held their usual monthly meeting at No. 30, Grosvenor Gardens, S.W., on Tuesday, April 8—Mr. D. Milne Watson in the chair.

Royal Commission on Mining Subsidence.

It was reported that evidence had been given on the 19th ult. before the above Commission by Mr. T. P. Ridley (Newcastle-upon-Tyne) on behalf of the Council, and that a comprehensive report of the proceedings had been published in the Technical Press.

London Traffic Bill.

It was reported that the various stages of this Bill had been so hurried forward by the Government that the Council had not had time to consult the different gas undertakings likely to be affected. Amendments had, however, been put down for the protection of the industry. The number of gas undertakings liable to be affected by some of the provisions of the Bill appeared to be over forty.

Railway Rates—Flat Rate.

The dismissal by the Railway Rates Tribunal of the application of the Mining Association for the removal of the flat rate of 2d. per ton on coal, coke, and patent fuel was reported.

Model By-Laws—Hot Water Installations.

It was reported that the Sub-Committee of the Ministry of Health who had been considering the specification in connection with the Water Model By-Laws had sent the Council a revised copy of their draft specification relating to hot-water apparatus. The draft was, however, still very unsatisfactory. It was agreed that arrangements should be made for a further meeting between representatives of the Council and the Sub-Committee.

Port of London—Increased Charges on Goods.

The Council decided to lodge a protest with the Ministry of Transport against the exorbitant increase in port charges on coal which were being put into operation from April 1—viz., 2d. per ton, representing an increase of 100 p.ct. on pre-war figures.

Scottish Matters.

Electric Lighting (Scotland) Act, 1890.

It was reported that the Scottish District Executive Board had called the attention of the Council to this Act, which had the effect of authorizing, if not actually compelling, a Town Council who owns both the gas and the electricity undertaking to meet out of the receipts for gas any deficit on the working of the electricity undertaking. The effect of this Act in recent years had been so serious that its amendment was highly desirable. In some instances gas consumers (50 p.ct. of whom were slot consumers of the artisan class) were being forced to contribute to losses incurred by the electricity undertaking.

It was suggested that a Committee should be appointed by the Scottish District Executive Board, together with representatives of municipal undertakings in this country, to investigate the question.

Grampian Electricity Supply Bill, 1924.

Attention was drawn to clause 21 of this Bill, which seeks to provide that, for the purpose of ascertaining the annual value of the undertaking, there shall be deducted from the gross income of the Company an amount equivalent to 7 p.ct. of the amount expended in respect of the impounding, &c., of water for the purpose of producing electricity. The same clause also seeks to provide that, for rating purposes, all the electric underground pipes, electric lines, and works belonging to the Company, and all overhead electric lines and standards, poles, and towers, and similar works, shall be assessed at only one-fourth of the annual value. It was reported that thirteen petitions had been lodged against the Bill.

It was agreed to circulate among members of the Board further particulars regarding the question of differential rating, and that the progress of the Bill should be watched.

Valuation, Taxation, and Rating of Municipal Undertakings.

A request was reported from the Scottish District Executive Board that representatives of gas undertakings should be allowed in connection with this matter to act in conjunction with the Committee of the Convention of Royal Burghs of Scotland. It was arranged that the Scottish District Executive Board should appoint representatives for this purpose.

Date of June Meeting.

It was agreed that the June meeting of the Board should be held this year on June 3—*i.e.*, on the first Tuesday of the month, instead of the second—inasmuch as the Whitsuntide holiday occurred in the second week of June.

Yorkshire Junior Gas Association.—On Saturday afternoon, April 26, the members are visiting the Globe Meter Works at Oldham, by invitation of Messrs. J. & J. Braddock. They will be shown the whole process of meter making, and will inspect the large erecting shop for station meters and station governors. The firm will entertain their visitors at tea at the Engineers' Club.

THE RECENT EVENTS IN YORK.

During the recent tripartite function at York—the celebration of the centenary of the Gas Company, the inauguration of the new vertical retorts, and the District Conference of the "B.C.G.A."—the second-mentioned event gave an opportunity for a photograph of the visitors to be taken on the works. We reproduce a copy of this. The original is 12 in. by 9 in., on an 18 in. by 14 in. white-plate sunk mount. Some of the visitors might like to possess copies. If so, the price, we understand from the photographer, Mr. T. J. Hanstock, 11, Clarence Street, York, is 5s., post free. Orders may be sent to him, or to the offices of the York Gas Company.

THE REMOVAL OF CARBON BISULPHIDE FROM COAL GAS.

A few years ago, when the Carpenter-Evans nickel process for the removal of carbon bisulphide from coal gas was introduced to the gas industry, the exceptional behaviour of the nickel in this particular process excited considerable scientific interest Hitherto, the presence of sulphur compounds, even in the most minute concentrations, had been regarded as fatal to any catalytic action in which this metal was involved. There had, in fact, arisen some doubt among those experienced in the use of nickel for promoting hydrogenation as to whether the process in question was one dependent upon true catalysis. While the inventors had no doubt of the catalytic nature of the process, they, too, were considerably puzzled by the apparent resistance of the nickel to the effects of such a powerful catalyst poison as sulphur.

Further work has elucidated this problem; and in a paper recently read before the Royal Society,* the authors show that the actual catalyst in the process is not nickel, but a sulphur compound of nickel having the formula Ni_3S_2. This compound, they point out, results from the reduction of the normal sulphide of nickel, NiS, and is also formed by the action of hydrogen sulphide on metallic nickel under temperature conditions such as those prevailing in the process. Whether metallic nickel or the normal sulphide is the initial agent in the process, is immaterial; the subsulphide is formed—in one case by sulphidation, and in the other by reduction—and equally satisfactory results are ultimately obtained in each case. The process is therefore no longer a scientific curiosity, but a new and very interesting example of catalytic action.

After explaining the behaviour of nickel in the process, the authors proceed to give the results of their investigations on the effect of temperature and promoters on the rate at which the removal of carbon bisulphide may be effected. It is shown that, by admixing the nickel with certain infusible oxides—notably those of thorium, aluminium, chromium, and beryllium—the activity of the catalyst is much enhanced. Thoria is superior to the other oxides in this respect; hence a mixture of nickel and thoria was selected for comparison with nickel at different temperatures. Not only did the nickel-thoria mixture prove advantageous in promoting a more rapid reaction, but it rendered possible a reduction in temperature of about 40° C. without any loss in the speed of the reaction compared with that given by nickel alone. Among the technical advantages arising from a reduction in the working temperature of the process is the lengthening of the intervals between which aeration of the catalyst becomes necessary; and further developments in this direction are anticipated.

* "The Removal of Carbon Bisulphide by a Nickel Catalyst." By E. V. Evans and H. Stanier. Presented by Henry E. Armstrong, F.R.S.

"Journal" Index.

The index for Vol. CLXV. of the "Journal" (January to March) is published with this week's issue. The one for the previous quarter was given with the number for Jan. 16.

MIDLAND JUNIOR GAS ASSOCIATION.

Visit to the Works of Messrs. Herbert Morris, Ltd.

About thirty members of the Association had the privilege, on Saturday, April 5, of visiting the works of Messrs. Herbert Morris, Ltd., the well-known crane and lifting-tackle manufacturers, and the Technical College at Loughborough. They were met at the station by Mr. W. Turnbull, representing the Directors of the Company, and proceeded to the general offices.

Subsequently a tour of the works was made under the guidance of Messrs. Robertson, Thorrington, Sudbury, and Smith. A great deal of interest was taken in the electric cranes, overhead cranes, and hand cranes, which were shown in the course of erection and actually in use in the shops. In the factory the transporter crane was seen at work; and the various machinery, lathes and presses used in manufacture were inspected. The works are exceptionally well organized, and are replete with every modern form of factory appliance, to eliminate as far as possible human handling with its consequent risks.

At the close of the visit, the members were conveyed to the tea room at the Loughborough College. After tea,

Mr. L. H. Thomas (President of the Association) proposed a vote of thanks to the Directors of Messrs. Herbert Morris, Ltd., and to the gentlemen who had conducted them through the works. He also thanked Mr. Mavor, who extended a welcome to the Association in the absence of Dr. Scholefield. Mr. Thomas stated that he had been struck by the efficient methods in the factory that had been inspected. He understood the new North Works of the Company would be the last word in efficient crane manufacture. He looked forward to the tour of the laboratories and workshops of the Technical College.

Mr. H. Clarke (senior Vice-President) seconded the vote of thanks, which was heartily passed.

Mr. Turnbull replied on behalf of the Directors, and in a few well-chosen words referred to the fact that, though the works of Messrs. Herbert Morris, Ltd., had little "gas" about them, all industries and trades were interdependent.

Mr. Mavor also replied on behalf of Dr. Scholefield and the staff of Loughborough College.

A most enjoyable afternoon of great educational value was spent by the members.

Society of British Gas Industries.—The annual general meeting of the Society will be held at the Holborn Restaurant, London, W.C., on Thursday, May 29 next, under the Presidency of the Rt. Hon. Lord Weir of Eastwood. The annual dinner is to take place in the evening. The programme of arrangements for the meeting will be announced later.

Notes on a Spiral-Guided Holder and Ferro-Concrete Tank.—Mr. Laurence R. Hislop, of Dundee, writes to point out the following errata in connection with his paper read before the North British Association of Gas Managers, as appearing in last week's "Journal," pp. 105-110: (*a*) P. 105, Right-hand column, 20th line from top, for 32 ft. read 34 ft. 6 in. (*b*) P. 106, fig. 2, for 35 ft. read 35 ft. 6. in.; for 16 ft. 6 in. read 20 ft. 6 in. (*c*) P. 110, right-hand column, 18th line from the top, for "attention in the past," read "attention of painters in the past;" also for "had been looked after properly," read "had been looked after properly by painters actually doing the work."

STANDARDS OF COMPARISON IN CONNECTION WITH THE THERMAL EFFICIENCY OF INTERNAL COMBUSTION ENGINES.

A Discussion introduced by G. James Wells, Wh.Sc., Assoc.M.Inst.C.E. [See *ante*, p. 101.]

All engineers interested in the efficiency of internal-combustion engines will have read the report of the former Committee appointed by the Institution of Civil Engineers in 1903, to consider the possibility of determining a standard for computing the ideal efficiency, and will remember that the standard finally recommended involved the use of air as the ideal fluid, together with the hypothesis that its specific heat was constant over the range of pressures and temperatures involved.

The Council, mindful of the progress made in the practical development of the internal-combustion engine, and in the actual increase of knowledge of the physics and theory of the behaviour of the gases during the cycle of operation, since the issue of the 1903 Committee's Report, have called together another Committee again to review the subject, and, if possible, revise and bring up to date the former Report. Naturally, the subject of the ideal cycles to be used as standards is fundamental, and calls for careful review and reconsideration, including the selection of the ideal working fluid to be associated with the cycles.

The working fluid involves the study of the physical properties of the actual mixture of the gases expanding, and being compressed, in the actual engine. One of these properties is its specific heat, which even now is a problem not completely solved. But the choice of a suitable fluid, as well as of a standard cycle, is obviously so fundamental that the present Committee have devoted much time to its consideration, and, in order to reach the best result, invite the co-operation of all the workers in internal-combustion engine problems, so that no vital point may escape full consideration before reaching the best conclusion possible under existing conditions.

Though the Committee of 1903 reported in favour of the air standard, it must not be overlooked that this conclusion was reached with some misgiving. They report thus on the matter of specific heat: "While realizing that when data are obtained, gas-engine calculations will have to be revised, and the variation of specific heat taken into reckoning, the Committee think that it is best in the present condition of knowledge to make use of the values which have been ascertained accurately at ordinary temperatures." It is evident that the Committee (a very strong one) of 1903 anticipated that the need for reconsideration would inevitably arise.

Sir Dugald Clerk (a member of the 1903 Committee) contributed a paper on "The Limits of Thermal Efficiency in Internal-Combustion Motors," which was read and discussed on Feb. 26, 1907, in which the air standard was considered at length. After stating the position, Sir Dugald Clerk writes: "The relative efficiency thus includes not only the actual imperfections of the engine cycle, but the variations between the actual properties of the working fluid and those of the ideal air assumed as a standard." Then follows a detailed account of the application of the method devised by Sir Dugald Clerk, and detailed in his Royal Society paper, to the results of the tests carried out for the 1903 Committee's information at the National Company's works. The method referred to is the so-called zig-zag indicator diagram, by means of which was determined the variation of specific heat at pressures and temperatures actually obtaining under working conditions in gas-engine cylinders. The results of the examination led to certain corrections of the results published, and the results are summarized thus: "The actual properties obtained from these experiments only give 39·5 p.ct. efficiency, while the air standard gives 49 p.ct. As the engine balance-sheet shows 34·7 indicated efficiency, $\frac{34{\cdot}7}{39{\cdot}5} = 0{\cdot}878$—that is, the actual engine converted 88 p.ct. of the heat which it possibly could convert into indicated work." From the figures quoted, it follows that the relative efficiency referred to the air standard is $\frac{34{\cdot}7}{49} = 0{\cdot}708$—that is, nearly 71 p.ct. Comparison between 71 and 88 p.ct. reveals an enormous difference in the possibility of improvement, and emphasizes the need for securing as the ideal fluid one which will give a closer agreement between the properties of the actual and the ideal working fluid.

The late Professor B. Hopkinson, Mr. Wimperis, and others have also discussed the effects of the variations of specific heat upon the ideal efficiency of internal-combustion engines. Very valuable work was done by the British Association Committee, which materially advanced the knowledge of the phenomena accompanying the combustion of gaseous mixtures in engine cylinders, &c. From these considerations it is obviously impossible for the present Committee to escape the duty of re-examining the subject and endeavouring to arrive at a fresh determination in the light of recent research.

The former decision was reached partially as the result of the search made for a standard that would involve only simple calculations; but it is obviously possible to obtain simplicity at too great a price, and it is now submitted that the need for simple mathematics cannot weigh so heavily to-day (with so many University trained men available) as in 1905. The solution of the problem submitted later is, however, quite as simple as regards computation as the present air standard.

Ideal Standards.

There are three simple symmetrical cycles, two of which appear to cover all types of internal-combustion engines at present manufactured. In each of these cycles the expansion and compression stages are adiabatic processes, and the reception and rejection of heat take place under (1) constant-pressure, and (2) constant-volume, conditions. Two other cycles must be examined which are combinations of (1) and (2). The first of these is the so-called "Diesel" cycle, in which heat is supplied under constant-pressure, and rejected under constant-volume, conditions; while in the other cycle, heat reception is partly under constant-volume, and partly constant-pressure, conditions, and the heat rejection is under constant-volume conditions. This last variant is that sometimes termed the "dual cycle."

The standard working fluid to be used with the standard cycles must next receive consideration, and is possibly the more difficult part of the problem to be solved by the Committee. The fluid in which the internal combustion engineer is interested is a complex mixture, and subjected to a very wide range of temperatures and pressures. The fuels employed range from producer gas to the so-called heavy oils utilized in Diesel engines.

A doubt naturally arises as to whether a fluid can be found which possesses suitable properties to meet the conditions formulated, and, if found, whether the necessary properties can be tabulated in a form suitable for use by computers, in a handy form similar to the well-known steam tables. The total energy and the internal energy are the two quantities principally required; and to determine these a knowledge of the specific heats is necessary. From the first, investigators have realized that the discrepancies between the pressures and temperatures attained in practice and those estimated are considerable. These variations have been explained as due to (1) delayed combustion; (2) the cooling action of the boundaries of the combustion chamber; (3) variable specific heat; and (4) dissociation effects at the high temperatures reached.

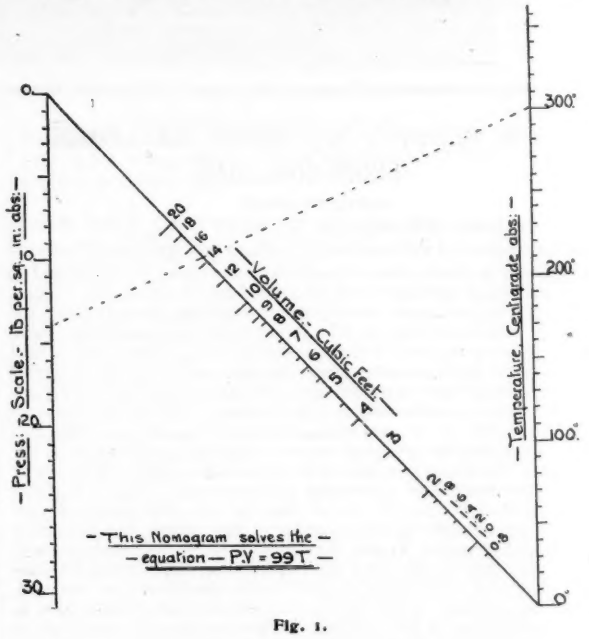


Fig. 1.

As regards (1), Professor Hopkinson's experiments appear to show that combustion is extremely quick, and that after-burning must be very small, if any. The cooling effect (2) of the walls is fairly well understood, so that it can be safely assumed that the explanation rests with (3) and (4). It is, therefore, necessary to examine (3) and (4), and seek a solution in as simple a form as possible.

The workers in this field include Sir Dugald Clerk, Grover, MM. Mallard and Le Chatelier, Prof. B. Hopkinson, Profs. Bairstow and Alexander, Prof. Burstall, and many others. The problem has been investigated under constant-volume, constant-pressure, and varying volume and pressure conditions. For the purpose of the present discussion it will suffice to summarize the present position as regards the specific heats, by calling attention to the apparent unanimity with which

$$C = a + sT + uT^2$$
$$\text{and } C_v = b + sT + uT^2$$

are the forms chosen to express the results attained. But no attempt appears to be altogether successful in separating in any quantitative form the effects due directly to dissociation. It is suggested later that it will be possible to select values for the constants in these equations, which give closely approximate values; and the expression so obtained may be called the "*apparent* specific heat," as preferable to "specific heat."

To reach probable values of the constants a, b, s, and u in the

above equations, by quoting the formula deduced by Mr. Wimperis from the conclusions of the British Association Committee on Gaseous Explosions—

$$C_v = 0{\cdot}1515 + 0{\cdot}000075\ T$$

(in C.H.U. units), or

$$C_v = 16{\cdot}66 + 0{\cdot}00822\ T$$

in feet and lbs. per c.ft.; also

$$C_p = 0{\cdot}2225 + 0{\cdot}000075\ T$$

(in C.H.U. units).

Sir Dugald Clerk's results obtained by means of the ingenious zig-zag indicator cards, may be expressed thus:

$$C_v = 0{\cdot}18 + 0{\cdot}00051\ T$$
$$C_p = 0{\cdot}251 + 0{\cdot}00051\ T.$$

Finally, Stodola has published the following:

$$C_v = 0{\cdot}167 + 0{\cdot}000062\ T - 0{\cdot}725 \times 10^{-8}\ T^2$$
$$C_p = 0{\cdot}2377 + 0{\cdot}000062\ T - 0{\cdot}725 \times 10^{-8}\ T^2.$$

The figures show considerable variation, and at first sight appear o suggest serious difficulty in realizing a basis for a new stan-

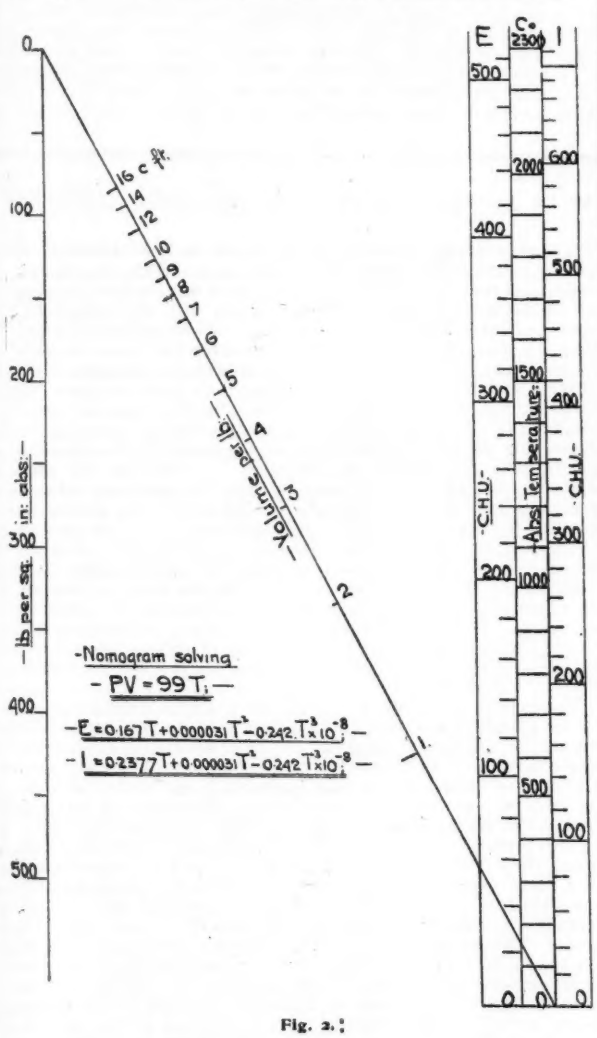


Fig. 2.

dard. Yet, Captain T. B. Morley has computed for the Otto cycle, with a maximum temperature of 1600° C., and a compression ratio of 6, that the efficiencies are 0·44, 0·435, and 0·45 respectively. The air standard for this case would be 0·512. Also in the gas equation]

$$PV = RT$$

$R = (C_p - C_v) = (a - b)$; and from the above three formulæ $(a - b) = 0{\cdot}071$, 0·071, and 0·071 respectively so that they are in practical agreement in assigning to R the value 99·4, or, in round numbers, say

$$PV = 99\ T$$

where P = lbs. per sq. ft.
V = volume in c.ft. per lb.;
T = absolute temperature Centigrade.

This result gives much encouragement to the attempt to find a possible standard fluid for use in computations.

The behaviour of the working fluid is known by means of an indicator card, which gives at once the simultaneous values of the pressure and volume at each instant of the cycle. It is possible that, in the future, values of the temperatures attained may be directly available. Having given P and V, then the above equation enables T to be computed; but it would be both difficult and cumbrous to attempt a schedule for values of T in terms of P and V. The obvious solution is by means of a nomogram or alignment diagram; and this is the practical method suggested for calculating the temperatures. The scales of the lines on the chart should be for P, lbs. per sq. in., temperature degrees Centigrade absolute, and volumes in c.ft. per lb. A chart suitable for this is shown in diagram form in figs. 1 and 2, and the dotted lines show how it may be employed. The alignment diagram solves the equation $PV = RT$, and therefore gives results for unit (1 lb.) mass. Take as an example a test in which the absolute pressure at the commencement of compression was 14 lbs. per sq. in. absolute, and the absolute temperature 300° C. Laying a straight edge so that it touches 14 on the pressure scale and 300 on the temperature scale simultaneously, it intersects the volume scale at 14·7 c.ft. The dotted line, fig. 1, shows the position of the straight edge.

The Internal Energy.—The change of internal energy (E) corresponding to a change of temperature from T_1 to T_2 is

$$= \int_{T_1}^{T_2} C^v\,dT = \int_{T}^{T_2} (b + sT + uT^2)dT$$
$$= b(T_2 - T_1) + \frac{s}{2}(T^2_2 - T^2_1) + \frac{u}{3}(T^3_2 - T^3_1).$$

Putting $T_1 = 0°$ (absolute zero of temperature), then this equation reduces to

$$E = bT_2 + \frac{s}{2}T^2_2 + \frac{u}{3}T^3$$

from which the total internal energy may be calculated and tabulated for future use. Inserting the constants used in Stodola's formula, this equation becomes

$$E = 0{\cdot}167\ T_2 + 0{\cdot}000031\ T^2_2 - 0{\cdot}242 \times 10^{-8} T^3_2.$$

The Total Heat (I) may be calculated in a similar manner, thus—

$$I_2 - I_1 = \int_{T}^{T_2} C_p.dT = \int_{T_1}^{T_2} (a + sT + uT^2)dT;$$
$$= a(T_2 - T_1) + \frac{s}{2}(T^2_2 - T^2_1) + \frac{u}{3}(T^3_2 - T^3_1)$$

Putting $T_1 = 0°$, and inserting the constants,

$$I_2 = 0{\cdot}2377\ T_2 + 0{\cdot}000031\ T^2_2 - 0{\cdot}242 \times 10^{-8}\ T^3_2.$$

In the appendix a short table containing these quantities will be found. In fig. 2 they are set out against the temperature scale of the nomogram, and in fig. 3 as a curve referred to heat units (C.H.U.) and absolute temperatures as co-ordinates.

It is evident, therefore, that the nomogram solves at once problems involving temperature, and internal and total heat changes.

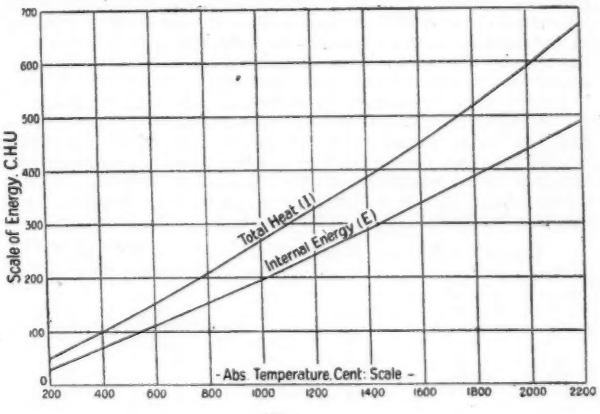


Fig. 3.

Therefore, efficiency calculations are readily effected, though the use of the equations might be found formidable by many, and in any case somewhat tedious.

The Temperature Entropy Chart is very useful for examining readily the departures of the actual engine cycle from the ideal. The diagrams already described actually give one-half, if not more, of the information necessary to construct the framework of the chart. In fig. 4 is shown in diagram form* the addition of the entropy scale together with some constant-pressure and volume lines, and the scales for reading-off intermediate values. The complete diagram is therefore a combination of fig. 2 and fig. 4, and this will give readily the solution to many, if not all, of the problems arising from a consideration of the test data obtained in internal-combustion engine trials. From Mr. Alexander's paper some examples of the use of the diagram are given. Each example gives results very close to those obtained in the orthodox way, and in each the results are easily obtained, so far as calculations are concerned. The results are much nearer the actual facts than the air standard, and the inaccuracies arising in conse-

* Reproduced from Proc. I. Mech. Eng., May, 1917, p. 336. Mr. W. Alexander's paper.

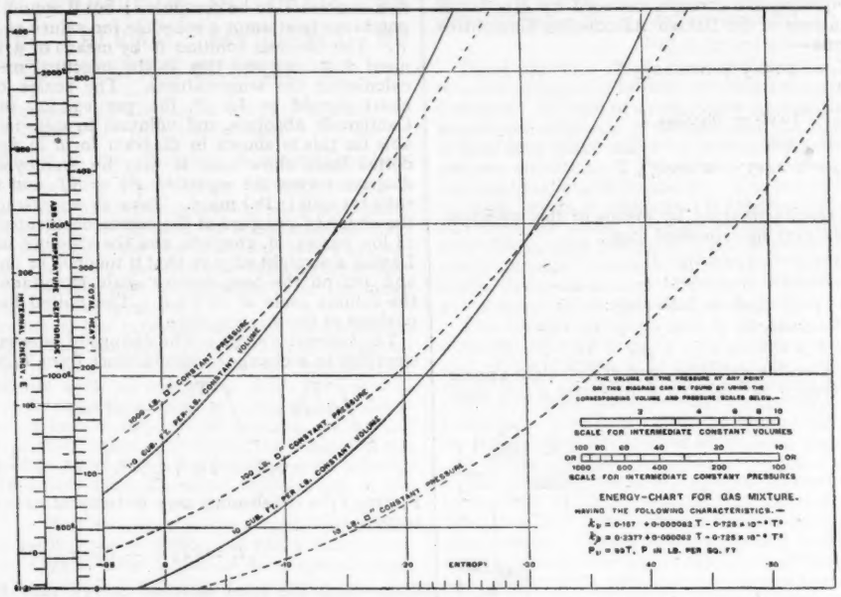


FIG. 4.—COMBINED CHART OF ENTROPY-TEMPERATURE (ϕT) AND ENTROPY TOTAL HEAT (ϕI).

quence of applying the same standard fluid to a gas-engine and to a Diesel leads to the conclusion that it is possible to substitute for the "constant specific heat" working fluid a "variable specific heat" fluid which will give a much closer approximation to the efficiences of internal-combustion engines than is now attained by the air standard.

It will be noticed that the evidence for dissatisfaction with the air standard is led by Sir Dugald Clerk, an authority on the subject under discussion; and no one may overlook what appears from his pen without incurring risk of trouble. The 1903 Committee also expected their findings to be reviewed. Next, the ideal standards proposed rest upon authority and contain only one novel point. This is the substitution of *energy* quantities for temperatures or compression-ratios, which was proposed by Mr. Alexander in 1917. In considering the ideal working fluid, every point is based upon work and suggestions made at various times during the last twenty years, and has been well examined by many experts, whose criticisms have reduced within narrow limits the discrepancies due to the values of the constants involved. The small variance in the values appears to have escaped attention in consequence of the closeness with which the details have been examined. The wood has been covered up and lost to sight because attention has been exclusively devoted to the forget-me-nots.

Finally the diagram method of solution has been proposed by Mr. Alexander, Prof. Burstall, Dr. Goudie, Captain T. B. Morley, and Dr. W. J. Walker, and will be found to be of some years standing, so that the suggestions made in this note simply direct attention to the possibility of utilizing existing material. It must not be taken that this presentation of the matter represents in any way the views of the Committee now considering the subject.

TABLE OF INTERNAL AND TOTAL ENERGY IN C.H.U.

Temp. °C. abs.	Internal Energy.	Total Energy.	Temp. °C. abs.	Internal Energy.	Total Energy.
0	0	0	1400	287·96	386·96
250	43·65	61·30	1450	299·87	402·37
300	52·83	74·04	1500	312·08	418·08
350	62·15	86·89	1550	324·35	433·95
400	71·61	99·89	1600	337·65	450·75
450	81·20	113·01	1650	349·18	465·88
500	90·95	126·20	1700	361·61	481·81
550	100·81	139·71	1750	374·29	497·99
600	110·84	153·24	1800	386·54	513·84
650	120·99	166·95	1850	399·63	530·43
700	131·27	180·77	1900	412·70	547·00
750	141·67	195·72	1950	425·71	563·51
800	152·20	208·78	2000	438·64	580·04
850	162·86	223·01	2050	451·80	596·70
900	173·65	237·30	2100	465·09	613·59
950	184·58	251·78	2150	478·31	630·31
1000	194·58	265·28	2200	491·64	647·24
1050	206·75	281·05	2250	505·18	664·28
1100	217·98	295·78	2300	518·67	681·27
1150	229·37	310·77	2350	532·03	698·13
1200	240·86	325·76	2400	545·91	715·51
1250	252·52	340·92	2450	559·56	732·76
1300	264·18	356·08	2500	573 70	750·40
1350	276·00	381·50			

The chair was occupied by Captain H. Riall Sankey, who, in his opening remarks, pointed out that the meeting had been convened by the Heat Engine Committee—a Committee consisting of members of eight different Institutions and other bodies. This Committee had agreed as a principle that the various points which might arise during their deliberations and their work should be placed before public meetings for discussion. This was the first meeting of the kind; and the subject-matter was the determination of standards of comparison in connection with the thermal efficiency of internal-combustion engines. It was really only a preliminary meeting; and when the Committee had gone carefully through all the additional information which it brought forth, another meeting would be called, when their final scheme would be submitted for discussion. He was sure they were all deeply indebted to Mr. Wells for the great trouble he had taken in preparing his paper. He (the speaker) suggested that the following points called for special consideration: (1) Whether the ideal cycle of comparison should work between the same range of temperatures as in the actual engine. (2) Whether it was practically possible to measure the suction temperature. (3) If not possible to measure this temperature, whether a certain figure could be accepted for two-cycle engines, and another figure for four-cycle engines. (4) The best formula to take for specific heat. (5) Whether an alignment chart, or nomograph, was satisfactory for practical operation. Mr. Wells had disclaimed having done anything new in his paper, and this was doubtless true in some respects; but his alignment chart method was his own, and if it were accepted, this fact should be remembered.

The lengthy discussion which ensued was appropriately opened by Sir Dugald Clerk, who did so much work in connection with the former Committee appointed by the Institution of Civil Engineers in 1903 (referred to in the opening paragraph of the paper). He said he agreed that it was desirable to go further into the methods of calculation of the thermal efficiencies of internal-combustion engines—on the basis of getting a real working fluid—and the properties of the real working fluid instead of the ideal fluid which they had used so long. But it should be remembered that, from many points of view, apart altogether from ease of calculation, the use of the ideal air at constant specific heat furnished a method for obtaining immediate results. One required to know nothing of the temperatures, pressures, and the working diagram; all that it was necessary to know was the ratio between the volume before compression and the volume after compression. However desirable it might be to secure better methods of determining the exact nature of the working fluid used and the standard working fluid, there were difficulties in the way, which he thought would leave the air standard cycle a sphere of usefulness for some considerable time to come. There was undoubtedly a great deal of work to be done yet, and he was very glad they had a thoroughly strong Committee of the different Institutions tackling the problem. More experimental work must be done; but the Committee had far more to go upon than had the old Committee, and so should arrive at a much closer approximation. He did not wish to lose his old friend the air cycle, though he would welcome the new one when it came along. To the points put by the Chairman, Sir Dugald offered the following answers: (1) To get an absolutely accurate ideal cycle, it should. They would not find one standard that would fit every condition. (2) He thought they had got pretty near the mark, but it was a very difficult problem to measure the suction temperature. There was room here for the younger men to come forward and seek a method. (4) As to the best formula to take for specific heat, he did not think they were in a position to get a really accurate formula. (5) He regarded the alignment chart as a very good move to save calculation.

Another member of the former Committee, Prof. Dalby, thought they would all agree that the paper stated the problems of the 1903 Committee very clearly, and brought to the solution of

these problems a knowledge which had been growing for twenty years. Nothing could have been more opportune than this paper, and the subject could not have been better dealt with. All their difficulties revolved round their imperfect knowledge of the specific heat of the working mixture. The author had said: "The internal combustion engineer has formulated possibly a more difficult problem, as the fluid he is interested in is a complex mixture, and subjected to a very wide range of temperatures and pressures. The fuels employed range from producer gas to the so-called heavy oils utilized in Diesel engines." He would like to say that the internal combustion engineer had formulated an almost impossible problem, because his working agent differed with different engines. The problem the Committee were faced with was really a very complex one. They were still confronted with the question of the suction temperature. They could make calculations perfectly complete, if they only knew this one thing. A thermometer had been suggested which could be withdrawn just before the explosion, and re-inserted immediately afterwards. A thermometer for the purpose was successfully made some years ago, and was described in the seventh report of the British Association Committee on Gaseous Explosions. [See "Journal," Vol. 127, p. 515.] This suction temperature question was right at the back of the present paper, and in this connection they were still in the same position as in 1903. They did not know what the real internal energies were, unless they knew the temperatures; and they could not find the temperatures unless they knew the suction temperature. As Sir Dugald Clerk had said, this was the most important point for investigators to solve. The 1903 Committee made two reports, and were practically wound up; and he did not think there had been another Committee of the same kind until the present time. This Joint Committee were the first to reconsider the problem. There was, of course, the British Association Committee, appointed through the influence of Sir Dugald Clerk, of which he (the speaker) was for some years Secretary; and this Committee did a great deal of work of one sort and another. It seemed to him that the air standard had some uses yet. It was very simple; and not only was it simple, but it provided something by which any engineer could measure right away roughly what his engine was capable of doing. But this did not mean that they must not continue to explore in every direction.

The next speaker—Mr. Pokobraaski—expressed the opinion that the 1903 Committee, while recommending the air standard, had shown much foresight; and if they took certain statements in that Committee's report, it would be found that they brought them right down to date.

The discussion was then continued by Messrs. F. H. Schofield, R. W. Bailey, Shilling, and R. H. Parsons.

The Chairman, in closing the debate, remarked that, though at the present moment they could not claim absolute accuracy, they were perhaps justified in establishing a standard, for in course of time they might make it more accurate.

Mr. Wells said the Committee started out to get something which could be easily used; and they were now really fishing for information.

INTERNAL CORROSION OF GASHOLDERS.

[A Paper read by Mr. C. A. Schuerr at the Annual Meeting of the New England Association of Gas Engineers.]

Corrosion of gasholders may be divided into two primary classes—external and internal.

External Corrosion.

This is due to oxidation, and acid attacks from the air and rain, and may be practically eliminated by good painting.

We have observed the crowns of certain holders, located near smoke stacks, and have found that cinders collected in offsets of plates, braces, &c., with ensuing acid corrosion evidenced under the accumulations. Holders should be carefully inspected for the presence of detrimentals such as cinders, and every effort made to remove them. Certain local conditions tend to induce corrosion at points in contact with holder water—for example, at the holder cups. Acid conditions in the tank water may be caused by various agents—hydrogen sulphide from the gas, going into solution; sulphur dioxide from the gas forming sulphurous acid; sulphur acids washed from the air by rain; and high concentrations of mineral salts or acids in water used to fill the tank. All these factors tend to cause cup corrosion, and should be guarded against most carefully, even to the extent of changing the water supply or purifying it, if necessary.

Galvanic action generally is blamed for many otherwise apparently unexplainable corrosion phenomena, but as a general proposition the external corrosion of holders is perceptible and easily prevented.

Internal Corrosion.

The principal factors causing internal corrosion of gasholders may be briefly summed-up as: Hydrogen sulphide, oxygen, and cyanogen compounds, with probably minor agents such as carbonic acid, sulphur oxides, and highly saline waters used to fill the tanks. Many believe that, as long as city gas can be forced into and out of holders, everything is well; but this thought should be ever with us—a gas containing the primary agents of corrosion (as mentioned above) will have a detrimental effect on steel or iron containers, when moisture is present, to a greater or less degree, depending on time, concentration, shielding coatings, &c., and while the holder appears to be perfect in outward appearance, you can be certain that the corrosive agent has taken its share of iron.

During the war period, under the stress of purification overloads, inferior raw materials, and necessarily less strict control, the prime impurities in manufactured gases became of greater importance than ever before. Sulphide stains were noted even at points of consumption. More oxygen passed through the purifiers, because, in efforts to improve the purification, a larger amount was admitted to the boxes. This phase of the trouble was of major importance, because of its effect, and impressive, because so readily perceived; but internal corrosions caused at the same time were not so impressive, because they were under the iron skin and not easily seen.

Corrosion in Holders Practically *Nil* under Good Conditions.

The corrosion in commercial holders, under good conditions, is practically *nil*, because hydrogen sulphide is absent, cyanogen is practically so, and oxygen is at a minimum. Some little rusting takes place internally, it is true; but many holders have stood for fifty years under such conditions, and inspection shows the metal to be good. The general economic trend of the period towards lower heating value gases, in conjunction with the practice of scrubbing condensible vapours from the gas at the works, eliminates practically all the oils formerly condensing in the holders and distributing system. Consequently, we are led to believe that corrosions will probably be somewhat increased because of the lack of the protective oil films.

Corrosion of Relief Holders.

Relief holders exemplify the action of the acid constituents of gases acting as corrosives. Even though coated with tar and oils, they rapidly corrode internally; and this is probably due to hydrogen sulphide in water-gas manufacture, or to that gas and cyanogen compounds in coal-gas manufacture. Relief holders are, as a general rule, small, and of less importance than commercial holders.

The writer recently received a communication relative to internal corrosion leading to ultimate failure of a large gasholder.

Cases of Holder Failures.

The holder was of 3 million c.ft. capacity, and contained about 2 million c.ft. of gas. A minor crown leak was noted, and a man went on top to make the repair. While he was there, the crown sheets ruptured over two-thirds of the circumference of a circle some distance from the curb of the crown. The man was killed in the ensuing collapse and combustion. This holder was twenty years old; and a very careful examination indicated that the failure was due entirely to internal corrosion, caused by an occasional inflow of imperfectly purified gas when running beyond purifier capacity. In another case brought to the writer's attention, examination of the interior of a relatively new holder, which had been in service one year, revealed the presence of abnormal scale formation.

Analysis of Scale Formation.

Occasional introduction of poorly purified gas had been noted; and it will probably be a matter of mutual agreement as to the direct cause of the corrosion when you have considered the following analysis of this scale.

	P.Ct.
Moisture	3·80
Oils, resins, naphthalene, &c.	7·73
Ferric ferrocyanide—Prussian blue	4·28
Silica	2·02
Ferric oxide	68·41
Iron sulphide	13·53
Ammonia	0·00
Carbonates	0·00
Undetermined	0·23
	100·00

Hydrogen sulphide would seem to be the primary cause of the trouble in this case, aided by oxygen and cyanogen compounds.

In another instance of holder failure, the writer had an opportunity personally to investigate the matter; and certain descriptions and conclusions are given.

Corrosion of a Four Lift Pit Holder.

This holder had a working capacity of about 4¼ million c.ft., and was twenty-eight years old at the time of failure. For 23 years the holder contained gas mixtures containing probably not more than 50 grains of hydrogen sulphide per 100 c.ft., and for the last 15 years of its life it contained some coke-oven gas containing traces of cyanogen compounds.

The holder failed through a tear across the crown for practically the full diameter. A careful examination indicated that the failure was due to two corrosive effects: The corrosion and deposit of corrosion products on the under or gas side of two crown plates, in the lap of the plates, tending to force the plates apart; and the selective corrosion on the under or gas side of the plates several inches from and parallel to the rivet line on both sides. This was indicated by perceptible thinness of the metal at these

points; and it was along such a thinned area that the initial rupture occurred.

Analysis of Deposit.

The deposit formed on the plate lap was analyzed carefully and found to contain:

	P.Ct.
Moisture	3·56
Free sulphur	4·13
Ferrous sulphide	17·10
Ferrous sulphate	0·16
Manganese sulphide	0·73
Silica	0·40
Prussian blue	0·20
Ferric oxide (Fe_2O_3, $3H_2O$)	1·99
Magnetic oxide of iron (Fe_3O_4, H_2O)	65·80
Organic matter and undetermined	5·93

Practically no cyanogen is present, but oxygen and sulphur are very prominent.

Analysis of Scale from Crown Plates.

A sample of loose scale was removed from the gas side of the crown plates, and analyzed as follows:

	P.Ct.
Moisture	1·58
Free sulphur	0·19
Silica	0·50
Prussian blue	0·17
Ferrous sulphate	2·19
Ferrous phosphate	0·69
Free iron	0·00
Ferric oxide (Fe_2O_3, $3H_2O$)	10·80
Magnetic oxide of iron (Fe_3O_4, H_2O)	73·10
Organic matter and undetermined	10·78

Analysis of Mud.

A sample of mud was taken from the top of the mound in the pit of the holder; and analytical results were as follows:

	P.Ct.
Moisture	39·42
Organic matter	5·64
Free sulphur	5·72
Ferrous sulphide	12·00
Ferrous sulphate	0·14
Ferric oxide (Fe_2O_3, $3H_2O$)	23·30
Prussian blue	2·25
Silica	0·00
Undetermined	11·53

Analysis of Metal of Crown Plate.

A sample of metal was taken from a cleaned crown plate, and analyzed as follows:

	P.Ct.
Combined carbon	0·09
Graphitic carbon	0·09
Chromium	0·00
Copper	0·26
Manganese	0·06
Nickel	Trace
Phosphorus	0·15
Silicon	0·18
Sulphur	0·041
Slag	1·45
Iron (by difference)	97·679

In addition to a chemical analysis, a metallographical examination confirmed the crown material as being wrought iron carrying 0·26 p.ct. of copper, which was an impurity in the iron manufacture and not intentionally added. Photomicrographs revealed very clearly the characteristic slag inclusions of wrought iron. A sample of water was also taken from the holder pit and analyzed. No acidity was indicated; and since destructive corrosion was evidenced on the interior of the holder crown, the possibility of the water carrying the active corrosive was remote.

How the Corrosion Took Place.

The procedure of the corrosion may be briefly outlined thus:

Condensed water vapour adhered to parts of the interior of the crown at points of least slope near the centre crown plate, and acted as a local collector of hydrogen sulphide, which attacked the metal or metallic oxide. This iron sulphide oxidized, and again sulphided, fulfilling the common purifying cycle. In the plate laps at the seams, the deposit accumulated. On the plate's interior surface, sulphide and oxide tended to dislodge and fall into the pit, thus exposing a fresh surface for further corrosive action. It will be noted that this holder-crown merely acted as a gas purifier.

City gas should not be put in holders if it contains hydrogen sulphide, sulphur oxides, much oxygen, or cyanogen compounds, if such practice can possibly be avoided. In cases where this elimination is impracticable—in relief holders, for example—a careful inspection should be made as often as possible. Particular attention should be paid to interior seam laps in the crown, and to the interior surfaces and thickness of the parts of the plates close to seams. This especially applies to the plate circles near the centre crown plate.

"Low-Temperature Carbonization."—This is the title of a new book published by Messrs. Ernest Benn, Ltd., of No. 8, Bouverie Street, E.C 4. The authors are Dr. C. H. Lander and Mr. R. F. M'Kay, and the price is 35s. net. A review will appear in an early issue.

GAS FIRING.

FLAME CONTROL.

By A. C. Ionides, Jun.

[A Paper read before the Society of Engineers (Inc.), on Monday, April 7.]

We have been familiar with the use of fire throughout history, as known to us; nor has this familiarity, even among engineers, been without its crop of proverbial contempt. Indeed, we are now told that there are some three thousand applications of fire to the Arts. When the foregoing is borne in mind, it would seem to require some courage to inquire into the principles of firing as a promising field for research. The author of this paper, nevertheless, is bold enough to do so, and even ventures a step further, and claims that the principles of gas-firing mostly employed hitherto are fundamentally wrong. It will be the object of this paper to uncover the grounds for such a conclusion, and to establish an alternative method. With respect to relative merits of hard and gaseous fuel, let it be observed that when we fire with peat, wood, coal, or any other hard fuel, we are really, though mostly unconsciously, heating with gas. The difference, for our purposes, is that when we burn hard fuel we are gasifying the fuel in a haphazard and wasteful manner, whereas in the other way we are doing so consciously, and delivering the fuel in a form which can be applied with far greater effect.

Times out of number has a heating device been fired with town gas far more economically than with hard fuel, *in spite of the therm in the form of town gas costing six times what it costs in the shape of hard fuel.* Consider the surface that a cubic centimetre of coal offers for combustion, in relation to that offered by the same amount of coal in gaseous form. In one case it is 6 square centimetres—in the other, it is computed in Oswald's "Colloid Chemistry," p. 27 (Dr. Martin Fisher's translation), to be 6 hectares, or 14·826 acres. This illustrates one point in favour of firing with gas. During fourteen years among heating propositions, the author has encountered but one good argument to support the use of hard fuel, against the use of gas. This was in connection with steam raising for power, and this was the argument: If it costs 30 p.ct. of the hard fuel to gasify the rest, how can an economy be claimed for a gas-fired boiler, when Lancashire boilers have shown over 80 p.ct. efficiency? This argument would seem to be wholly unanswerable, if it were not for the bye-products of gas making, and the cost of labour for handling hard fuel. A margin for economy is assured where a heating operation with hard fuel does not reach 70 p.ct. efficiency; and which of them reaches anything like that? The average efficiency for steam raising for power is 56 p.ct. (Mr. David Brownlie's figures); that of melting, annealing, and heat treatment of metals, about 15 p.ct. In glass-making the efficiency may be as high as 18 p.ct. —the author has known it as low as ½ p.ct. In pottery, Mr. Bernard Moore, one of our best authorities, assured the author it was under 2 p.ct. Steam raising is said by Mr. Brownlie to consume 60 p.ct. of the fuel used in this country. But of the whole 200 million tons of coal consumed here, only some 20 millions are used by the gas companies. So there seems a very strong case for extended gasification. Anyway, it would seem to be a criminal offence to continue the present use of raw coal, and distribute valuable bye-products in the form of dirt over this fair land.

The description of an experiment will illustrate what the author proposes: Pass a silica tube, say $\frac{1}{16}$-in. bore, slightly flared at one end, through a hole in an asbestos washer, and connect the unflared end with rubber tubing to a supply of a neutral self-supporting mixture of air and gas (*i.e.*, a mixture which, when burnt, will not yield, in the products of combustion, any excess of CO or O), fix this to a stand with a clamp, heat the flared end of the silica tube, turn on the mixture, and ignite. Now take a test tube likewise of silica glass, fixed to a clamp of similar length to the other; enclose the lighted end of the silica glass tube with the test tube, and note what happens. If this be done gently, so that the test tube gets gradually warmed, the flame will not necessarily go out, as might be expected, but will continue to burn. As the test tube gets heated, the flame seems for the most part to vanish. When the closed end of the test tube shows a good colour, place the asbestos washer against the open end of the test tube. Behold, it continues to burn as efficiently as ever. Of course, the asbestos washer does not hermetically seal the test tube, or the pressure therein would increase, and the flame go back. Now, what are the interpretations that can be given to this experiment?

The author submits the following:

1.—*That draughtless combustion is possible.*

2.—*That hot products of combustion, far from impeding combustion, as might have been previously assumed, may be used to assist it.*

3.—*That the volume of the products of combustion, after they are sufficiently cooled, occupies a smaller volume than the incoming gases, and that, as far as gas-firing is concerned, vertical chimneys and an upward draught are an anachronism.*

In order to make use of this information, a problem of first importance arises. How is it possible to ensure a constant ratio of air to gas when the two are delivered at varying pressures, and even when equal in the delivery pipes they are again varied by the amounts consumed at the other end? The solution of this problem took four years—it is called a pressure balance, and

considering the nature of the problem, is a device of extreme simplicity.

Pressure Balance.

Fig. 1 shows the general arrangement of this apparatus. A is an inverted bell, which is immersed in an oil seal at B contained in the space between concentric tubes C and D. Sus-

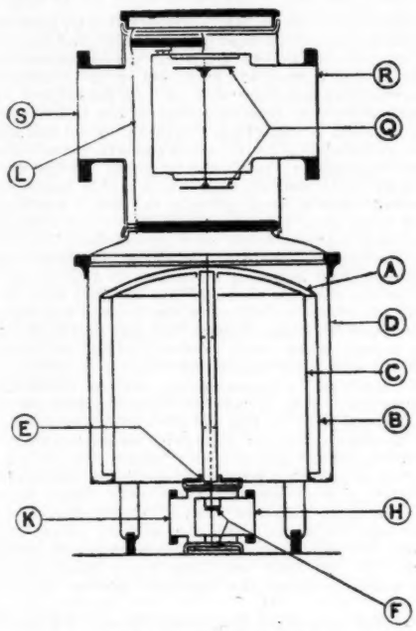


Fig 1.—Pressure Balance.

pended beneath the bell A by means of a rod and connections E is a double-seated balanced gas-valve F. The gas, passing in at H through the valve F, operates on the underside of the bell A, and, its pressure being under control, passes out at K. From the top surface of the bell other flexible connections L connect it to the double-seated balanced air valve Q. Air is introduced at R, passes through the valve Q, and leaves at S, its pressure being under control. The air pressure in passing through the valve Q is allowed to act upon the top of the bell A. The whole apparatus, comprising flexible connections, air and gas valves, and bell, is balanced at atmospheric pressure with the bell dipping into the oil seal. Excessive air pressure on the upper surface of A causes the bell to descend, and in doing so the gas-valve is opened and the air-valve is closed until the pressure at S exactly equals that at K. Should the pressure of the gas rise, the bell also rises, opening the air-valve and allowing the controlled air pressure to rise to an exactly equal amount. If, on the other hand, the gas pressure falls, the air pressure is similarly automatically reduced. From the pressure balance the gas and air are conveyed by separate mains through mixing valves, situated on the furnace or other appliance to be heated.

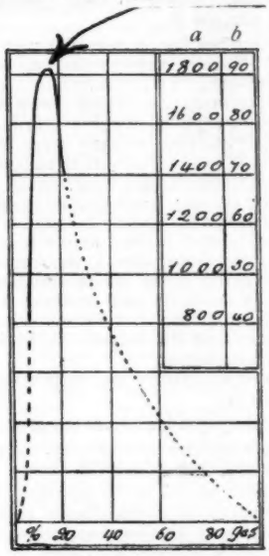
The diameter of this bell A for a 3-in. main is 19 in., and the area on which the pressure acts is 283·5 sq. in. It is so sensitive that the mixture for one light consuming less than 3 c.ft. of gas per hour is well maintained. It can, in fact, be made sensitive to $\frac{1}{100}$ in. water gauge. Now attach a pressure gauge to the air outlet of the pressure balance, and another to the gas, and partially close the inlet valve to the pressure balance. Behold, the two pressures decrease simultaneously—*i.e.*, without any observable lag. Now open out that valve again, and they increase similarly; and if beyond the heating device in use, be it a light or a furnace, you open an air or gas cock, the same result is obtained. The accurate and simultaneous action of this device is barely credible, until observed.

A prejudice—a prolific source of waste—still prevails, that if you wish to get an increased temperature it is necessary to use more gas.

1.—This prejudice can be dispelled merely by a cursory glance at the curve shown in fig. 2. This will establish the fact that, with a 2 to 4 p.ct. difference either side of the peak of the curve in the ratio of the volume of air to gas, the temperature of a flame will fall from 200° to 400° C.

2.—It will convince the unprejudiced that gas can be burnt indefinitely to attain a given temperature, without doing so (except by accident) unless the right mixture be attained and maintained.

It is, nevertheless, true that not one in a thousand heating devices is provided with any means of doing either. The author has, times out of number, offered to *accept reward on results alone*—*i.e.*, that he should share in the economy his system actually afforded, without other payment—but has had the offer refused. Why? The answer would seem to be that a board of directors are not usually equipped to take cognizance of such matters. The executive—the technical staff—are given no financial interest in the economy afforded; and in consequence, when such a proposition is put before them, they only see a possible disturbance in the works, and neither kudos nor pecuniary benefit to themselves. This is how most fuel-economy suggestions fall to the ground. It is a scandal that, in the twentieth century, a country in straitened circumstances owing to a disastrous war should



Curve showing Heat evolved (a) in °C with various mixtures of Gas and Air; the necessary saving by firing with a Constant Mixture.

Pressure (b) produced in lbs. per sq. in. (obviously to be avoided in pipes). Drawn from figures published in Vol. LXXXV. Proc. Inst. Civil Engineers (Dugald Clerk).

Fig 2.

continue to waste half of the 200 million tons of coal it uses per annum.

It may here be useful to point out a fundamental difference between an open flame and the burning of gas in an enclosed space. In the case of the open flame, secondary air is available and applicable. In the case of the enclosed space, it is not efficiently applicable, though it can be made available. The bunsen burner was devised for an open flame in 1855, and the difference between these two problems is in most cases still unrealized. Perhaps, some time within the next fifty years some may realize that, to attain any considerable temperature in an enclosed space, the most efficient way is to do it *without any draught at all*.

Now let us pass some air and clean gas through a pressure balance to a burner where the gas and air mingle as intimately as may be at, but not before, the point of combustion. Further, let the flue gases be displaced downwardly. What happens? First, you have draughtless combustion, and the greater the temperature the greater the pressure in the combustion chamber against the incoming gases. A thermostatic condition has been established. Your heating device is set once and for all for a given purpose. You attain your object every time, and are no longer at the mercy of shifting winds and highly-paid men, skilled in regulating dampers, &c., to cope with an astatic thermal condition. Now let us move a step further. Displace these products of combustion downwardly in such a manner as to improve the insulation of the heating device. This is to be done as follows: Assuming you are firing from the lower part of your heating device, wherever possible let the flue gases take the longest path. You would therefore fire the combustion chamber (say, of a crucible furnace) tangentially below the crucible, which would stand in a vortex of flame, while the flue gases would swirl in a vortex through and from a hole in the top of the combustion chamber, round and down an annulus left for this purpose, between the outside of the wall of the combustion chamber and the inside of the outer wall of the furnace. The flue gases are collected from a disc-like space between the outside of the floor of the combustion chamber and the inside of the floor of the outer casing into a central pipe, forming part of the stand of the furnace, and thence pass out of the building. It is to be noted that, by such an arrangement, heat is given by the flue gases to the outer walls of a furnace which otherwise would have to come from the combustion chamber, and that, by the amount of heat so given, the insulation has been enhanced.

The author has now submitted his case—

1.—Against some prevailing methods of firing.

2.—For replacing hard fuel by gas.

3.—For a pressure balance to secure a constant relation between air and gas so long as the gas is of even quality.

4.—For a pilot flame to correct for alteration in the quality of gas.

5.—For draughtless combustion—(*a*) its thermostatic effect; (*b*) its enhanced insulation.

These principles have been demonstrated, in so far as they have afforded substantial economy wherever they have been applied. The following are examples of the order of the economy they effect:

1.—13 p.ct. on low-temperature annealing in a 78 in. by 72 in. by 18 in. furnace.

2.—About 50 p.ct. in the case of an air heater at one of the largest munition factories.

3.—Over 50 p.ct. on forging heats against a Brown and Sharpe furnace—*i.e.*, gas *versus* gas.

4.—Where a well-known munition firm took 7·02 c.ft. per lb. for aluminium melting under working conditions, the author built a 250 lb. furnace to meet their requirements, and averaged 3 c.ft. per lb.

But why insist further that a very unnecessary waste of fuel prevails? It is generally known. Indeed, some have recommended that a heat expert be appointed to every factory. This may be sound philanthropy, but would rarely result in economy; for even if there were experts enough to go round—and there are not—would not their salaries, in many cases, be as much as, and more than, the fuel saved? The author believed that once such achievements had occurred, the door would be open to much saving of fuel. But not so; much unhealthy prejudice, rooted in unenlightened interests, vested and otherwise, still hovers around.

When the experiment described above was first made, some fourteen years ago, the author saw, in the future, our land something like this: No chimneys at all; the desolation of the Black Country replaced by sunshine and verdure; industrial cities on eminences; and the products of fuel combustion gravitated back to fertilize the plains and the valleys. Whether this be dream or divination, time will decide.

The American gas companies are quite frank about it—their attitude is that they are

"Out to sell, and not to save."

As regards the gas companies over here, the author will relate one or two experiences he has had with them:

(*a*) In 1915 he informed 268 gas companies of his discoveries. He received seven acknowledgments, and one answer.

(*b*) To another company he offered to furnish a complete installation for their showrooms, providing they would give him the authentic consumption of the devices they were selling. His apparatus was actually installed, when the company's engineer refused to give the figures of consumption by devices sold by them, alleging that it would not be fair to their manufacturers. His installation was removed.

(*c*) With yet another company, the author had arranged that a firm of manufacturing opticians should instal a series of furnaces, providing the company would give him, as royalty, a portion of the industrial discount, dependent upon the economy afforded. This company refused to instal on these terms.

(*d*) In 1914 a controller of gas sales visited the author's laboratory, and though subsequently kept informed of the progress of these achievements has not deigned to betray any interest beyond putting the author in touch with a manufacturer.

(*e*) This manufacturer was in touch with the author for four years. At the end of this time he offered to give the author 5 p.ct. of the profits he made out of the inventor's devices. The offer was rejected.

(*f*) While ostensibly developing the author's patents, this manufacturer brought co-operation to an end by taking out patents himself on similar lines.

(*g*) Admittedly spending over £700,000 a year on fuel, and finding after a year-and-a-half's trial that the author's methods saved 50 p.ct. of this, the manufacturer came to an agreement for eighteen months. *Subsequently he refused to comply with the terms of this agreement to measure his fuel consumption, and turned-out the system because the author insisted on this condition being fulfilled.* Then followed four years' litigation. The manufacturer has yielded on every point. *Will any of my readers kindly inform me how economy in fuel can be effected, unless the consumption on each heating device be measured?* Common sense would seem to dictate that effective fuel economy is impossible without measuring the fuel consumed, and it is mainly because of this that the author insisted on taking his royalty in the form of a percentage of the saving. And yet the fact remains that the biggest obstacle to fuel economy is the point-blank refusal of most manufacturers to measure and ascertain their fuel consumption on each of their heating devices.

(*h*) Another manufacturer, measuring his fuel consumption, found the author's system started by yielding him a 29·4 p.ct. economy in 1921. His last returns in 1923 show a 58·2 p.ct. economy.

This brings the story up to the present. Now with respect to the future.

So far, in Great Britain, 90 p.ct. of the fuel used is still ungasified. Only some 20 odd million tons of coal are passed annually through the retorts of gas companies. The annual cost of their products, to the consumer, is not less than 40 million pounds sterling; and since the minimum waste through lack of complete combustion is 30 p.ct., it is clear that a minimum of 13⅓ millions sterling, on town gas alone, is wasted yearly. In so far as this only represents a minimum wastage of 10 p.ct. of the fuel consumed, and this is far greater in solid fuel than in gas, you will appreciate the order of magnitude of the amount of fuel wasted in this country alone.

The Government has started a Fuel Research Board, which has spent hundreds of thousands yearly. The Press has embarked on a campaign against the waste of fuel. The subject is referred to in articles and speeches by Mr. Lloyd George, Lord Haldane, Lord Milner, and others. There is also various correspondence on "Smokeless Cities." All this may help to draw attention to the evil that exists; but the evil will go on until we realize that it can vanish only by means of *gasification, and complete combustion.*

Discussion.

The President (Mr. G. A. Becks) remarked that, after hearing Mr. Ionides read his paper, the chief point which presented itself to his mind was the fact that he had asked 268 gas companies to consent to a reduction of their output, and expressed in no measured terms his annoyance that they failed to "enthuse" on the subject. Personally he was not surprised at their reception of the announcement. For small furnaces, and perhaps larger ones—he could not quite realize that the invention should be limited to small furnaces—the proposals put forward appeared to be eminently good. In the case of firing big boilers, he could well imagine that a steady constant flame, or even a constant eddy of flame (because the flame would presumably be directed upon some refractory material), might prove injurious to steel plates, and that gas might be "turned down" for this reason; but some arrangement could no doubt be introduced whereby the burner could be kept in gentle movement to and fro, so that there would not be the constant flame or the constant eddy in the same spot. The object of their Society, he hoped, was not merely to derive instruction from their fellows, but also to afford such help as they could to each other; and to this end he was led to ask wherein lay the "snag" which prevented this valuable invention from being immediately accepted? He must admit that he could not reply to his own question. Was it that the first cost was not sufficiently attractive? It could not be that the profits were insufficient to justify the outlay, for there were given in the paper large percentages of saving. Therefore he hoped the author would pardon him for asking point-blank: "Does he approach possible customers in the right manner?" It was a great pity to see an undoubtedly clever invention cast to one side for some unknown reason. Could they find out what this reason was, so as to assist the author? The proposal was an extremely interesting one, and should prove of great value to likely users. It had been very clearly put before them by Mr. Ionides, to whom he asked the members present to record their thanks.

Mr. J. E. Hearn remarked that he was present as a member of the firm who had had this system in operation from January, 1921. On an average, for the first two years and nine months their economy was 33 p.ct. Just before the end of that time, a new furnace was constructed for employing the flame immediately upon the metal being melted; and the result had been that for the following quarter the economy had reached, as mentioned by the author, 58·2 p.ct. So far as their records went for the past quarter, they thought possibly they might even improve upon this; they would at least equal it. The terms of Mr. Ionides to his firm were very generous. His offer was an alternative one—he would accept either a percentage on the economy his system afforded, or a lump sum payment.

Mr. J. W. Gordon said he was very glad to hear the remarks of the President, who had drawn attention to what was perhaps the most important advantage that could be derived from the reading of a paper before the Society—the help of fellow members. The results of the publicity given to a paper which he himself read recently before the Society had been such as he was disposed to appreciate very highly, and he hoped that the same sort of thing would happen to Mr. Ionides. It was very necessary that the facts which had been ventilated that evening should come to be generally known. The evidence that Mr. Hearn had given of the results of the application of this method, if it could only be made sufficiently widely known, should certainly lead to extensive inquiry. Could the author give them any hint as to the best way in which to make the facts known, and to cause them to be appreciated? These were two quite different things. In what directions would it be most useful to look for the kind of interests which could be stimulated by communicating this information? Apparently it was not much use to go to the people who used Lancashire boilers, or to those using other appliances, if their efficiency amounted to as much as 70 p.ct. Then it was perfectly obvious that there were other purposes to which the system could not be applied—for instance, locomotives. He did not know what the consumption of coal was by locomotives. There was one other point which he would like elucidated. The author spoke of "draughtless combustion." No doubt the term was a technical one, and it would be interesting to have it explained.

Mr. C. Percy Taylor, referring to the lack of appreciation of this method of controlling gas combustion, said he could not help thinking that, while the technical results quoted were perfectly sound, the case had been a little over-stated. He did not see how it would be possible to apply gaseous combustion in place of the 200 million tons of coal alluded to in the paper. Until one could buy therms as cheaply in gas as in solid fuel, it was difficult to make a success of gas-firing, unless a process demanded this method. In that case, he had no doubt this system of controlling the flame was extraordinarily good. Many commercial firms hardly knew what fuel they did use, and certainly they did not know how they used it. In so far as technical factors affected the situation, the reason why these things were not taken up more rapidly was mere ignorance. If they could once get industry to realize the absolute necessity of measuring everything they used, this state of affairs would be altered.

Mr. Finlayson appreciated the paper very much, but did not see how Mr. Ionides proposed to do away with chimneys entirely. It would also be interesting to have figures of the previous efficiency of appliances in which he secured such great economy. One could see that in the melting of metals and in refining a furnace of this sort ought to work very well indeed.

Mr. J. H. Gardiner had been struck by one point the President had raised—namely, that it was perhaps not surprising that gas companies were not prepared to take up a principle of firing by which the consumption of gas by customers would be reduced considerably. This was a very narrow-minded view of things to take. He had no doubt

that, if the new method of firing to which Mr. Ionides had devoted his life and energies became fully appreciated, it would not have the effect of reducing the demand for gas. He would like to say one word in connection with his own personal experience of the furnace in question. It was a small one used for experimental glass melting, and he certainly found that, compared with the furnace he had been using previously (one of the most up-to-date at that time), the consumption of gas was very considerably less with the Ionides method than he had been able to arrive at before, and the ease with which the gaseous mixture could be controlled was excellent. But he would like to ask Mr. Ionides whether he had finished, or whether he had so developed his invention that one could have a dry balance. His (the speaker's) experience with the oil pressure balance was that if he were using the furnace simply as a tool to enable him to carry out various experiments, so that his attention was fixed not on the furnace but on the crucible, there was always a fear in his mind that he might blow the oil over into the valve. With the author's arrangement, the amount of heat one could obtain was practically unlimited, and this brought in the difficult question of refractories. Unless one was careful, the temperature might be run up to such a point that nearly all the known refractories would give way. He did not know whether there was any further development at present with regard to refractories that would withstand 1700° or 1800° C.; but, if so, it would be a very great convenience to users of these furnaces for experimental purposes. One could only hope that the advantages of the invention might be made more generally known.

Mr. F. C. EVENNETT asked whether there was any danger of back-firing with these furnaces.

Mr. IONIDES replied that there was not.

Mr. W. NEWTON BOOTH had been very interested listening to the lucid description of the author's experiments and the apparatus he had evolved, and to the conclusions and arguments based thereon; but he could not help feeling that, in summing up the points in favour of his appliance, the author had much overstated his case. To take his own figures, he said that there were 200 million tons of coal used annually in this country, and went on to suggest that this was a fair figure on which to base the estimates of economies which could be effected by the use of his apparatus. Mr. Brownlie's estimate was that 60 p.ct., or 120 million tons annually, of this coal was burnt under steam boilers. It was not very long ago that the Power Sub-Committee of the Nitrogen Products Committee of the Ministry of Munitions went very carefully into the question of the economy of gasifying coal and recovering the bye-products therefrom before using it for power purposes. In spite of the fact that it was recognized that, with properly designed gas-fired boilers, it was possible to secure thermal efficiencies of well over 90 p.ct., reckoned on the net calorific value of the gas, and that at that time the bye-products of coal distillation were at high prices, they were forced to the conclusion that, on the grounds of economy, there was no case to be made out for coal gasification for boiler firing. In order to obtain this high efficiency—or, indeed, anything approaching it—with gas-firing, it was necessary to have the boiler plant specially designed for the purpose, and it would thus not be economical to apply gas-firing to existing installations without considerable expenditure on alterations and reconstruction, or unless the gas was an otherwise waste product. Such considerations would reduce very substantially the amount of coal which should be brought into the author's argument. A considerable quantity of coal was used industrially in gas-producers worked under non-recovery conditions, and where, therefore, the gas was distributed to the furnaces hot and containing a quantity of both tar and dust. In many cases it would not pay to attempt to remove these impurities, and it would seem that the pressure balance would not work properly with gas of this kind. Dealing with town gas, the author stated that some 20 million tons of coal annually were passed through gas-retorts. The efficiency of gas production would not be higher than about 25 p.ct.—*i.e.*, only about 25 p.ct. of the thermal value of the coal would be returned as gas, the remainder being comprised in coke (say 55 p.ct.), tar, and that lost. The coke would have to be used as a solid fuel. Of the total output of gas by gas undertakings, over 80 p.ct. was used in open-flame burners, leaving less than 20 p.ct. to be burned in enclosed spaces such as had been described by the author, and for which his appliance was intended. He did not wish these remarks to be construed as tending to minimize in any way the importance of the author's work, but merely as supporting the view that the claims made had been rather overstated. Any worker on the design or use of appliances using gas-flames in enclosed spaces could not fail to be struck with two facts. First, that, as stated by the author, success depended primarily on the ability to control accurately the exact proportion of gas to air in the combustible mixture. It was impossible to secure high temperatures if this condition was not fulfilled. Secondly, most of the appliances in common use came very far indeed from realizing the ideal. Most of the small coal-gas fired furnaces which were in use up to a few years ago had alarmingly low thermal efficiencies. He had in mind tests of his own in which furnaces that were looked upon as good of their kind gave efficiencies of under 5 p.ct., and when 10 p.ct. was reached this was considered a very good result. Much higher efficiencies could, however, now be attained, if proper care was bestowed upon the construction. To return to these figures, it was interesting to inquire what became of the balance of 90 p.ct. of the heat supplied. Roughly half of it was conducted away through the walls of the furnace, and the other half passed out as sensible heat of the waste gases. The method described by the author of jacketting the combustion zones of his furnaces with hot waste gases was sound, and did lead to a very great saving in the total heat loss from the appliance. This idea, however, was by no means new, patents covering it having been granted over half-a-century ago. The particular virtue of the method lay in the fact that the heat lost was supplied from the waste gases after they had done their useful work in the combustion zone, and not from the high-temperature gases in the combustion zone itself, where, owing to the high-temperature at which the gases left, the transfer of heat could only take place at a relatively low efficiency. With regard to the downward displacement of the hot gases, he was also in agreement with the author. When there was little turbulence of the gases, as in the author's heating chambers, the natural convection currents in the gases led to the hottest gases occupying the top of the chamber and to the coolest layer being at the bottom. If, therefore, the waste gases were taken from the top of such a chamber, they would not be cooled so effectively as if taken from the bottom, and so the loss in their sensible heat would be higher. There was thus a very distinct advantage in the latter method. The figure given by the author of 200° C. as the temperature of the waste gases from one of his furnaces working at 1400° C. struck him as indicating that insufficient trouble had been taken to minimize the loss by conduction through the walls. In his own experience it was quite feasible, with carefully constructed walls, to reduce this loss to the equivalent of cooling the waste gases by only about 400° C., corresponding in this case to a temperature of 1000° C. for the waste gases. At such temperatures the sensible heat of these gases represented a very serious loss, amounting to over 50 p.ct. of the thermal value of the fuel gas, an amount sufficiently high to warrant very careful investigation. This point had not been mentioned specifically in the author's paper, and he would like to ask whether Mr. Ionides had been able to combine his pressure-balance system with a device, such as a recuperator or regenerator, for recovering some of this waste heat and returning it in useful form to the heating zone.

Mr. A. S. E. ACKERMANN (the Secretary) emphasized the importance of measuring all fuel used in industrial operations. He had had the pleasure of visiting the author's laboratory, and had seen how beautifully the pressure balance worked.

Mr. IONIDES, in the course of his reply to points that had been raised, remarked that ships' furnaces were fired by gas. It was true it was dirty gas, and it should be a clean gas to employ his system. Some day it would be an economy to clean gas, as the tar, &c., in gas were valuable. The prime cost it had been suggested might be an obstacle to the adoption of his invention; but this was not the case. The first large installation he put in was for a firm of munition makers. They were using what they termed a barrel furnace to forge gun barrels. The furnace cost them, with the pressure balance, £60, and they made a saving of £87 a year. Prime costs did not really stand in the way where any considerable amount of fuel was involved. For domestic use people would not pipe for air in the first place, and, secondly, installing a pump to give air under pressure was out of the question; but there were many furnaces in all kinds of industries, consuming a very considerable amount of the fuel used in this country, which could be fired by gas, and by a clean gas. He could not mention all the directions in which the economies he urged might take place; but he might refer to the tin-plate trade, glass making, metal treatment, the chemical trades in heating liquids in large quantities, and the manufacture of aluminium. In all these processes gas could be used with great advantage. Mr. Gardiner had one of the first pressure balances made, and the seal was not sufficient to withstand his pressure; but he thought Mr. Hearn would bear him out that the pressure balance as constructed for 3-in. mains was, as far as anything could be, "fool-proof," which was what Mr. Gardiner was asking for. He himself had had one for four years in his laboratory, without its requiring seeing to at all. There seemed to be some idea that large boilers could not be fired by gas. He had had a visit from an American who had constructed 20,000 boiler horse power to run on dirty gas, and he used an incomplete form of pressure balance. Why should it be done in America, if it could not be done in this country? The President had said that possibly he (Mr. Ionides) did not approach likely clients in the right way, and he was prepared to accept this, as he was not very conversant with such matters.

BUILDING TRADES EXHIBITION AT OLYMPIA.

Points Which Bear upon an Urgent Problem.

The serious shortage of houses existing at the present time was emphasized by the Right Hon. John Wheatley, Minister of Health, when opening, on Friday last, the biennial Building Trades Exhibition at Olympia. An idea of the problem by which the country is confronted will be gathered from his remark, with regard to this shortage, that unfortunately things are not getting better. It seems that in order to prevent the shortage from growing, there is required an annual output of at least 100,000 houses suitable for that portion of the community who, unable to afford to own the houses they occupy, have to depend for accommodation upon places which they can rent. The number indicated is needed in order to meet the normal depreciation of property and the expansion of the population. These 100,000 houses annually are not now forthcoming, with serious consequences from more than one point of view.

There are, of course, various reasons for the continuance of this shortage, and the problem is far too complicated to allow of hope that any exhibition could entirely solve it. But anything making for cheapness, simplicity and rapidity of construction, soundness, and attractiveness must have an important bearing upon the question; and so the Building Trades Exhibition of 1924 will be hailed, at this juncture, with particular satisfaction. Mr. Wheatley himself fully recognized the importance of the exhibition in his appeal to, among others, the manufacturers to consider how the methods of production could be improved to the greatest extent, so as to ensure that the increased demand for building materials would not result in an increased price for those materials. The show is a good one, the added area now available affording opportunity of exhibition to many manufacturers who, by the exigencies of space, have hitherto been excluded. An educational feature is the holding of handicraft competitions among students in the building trades throughout the country. Prizes and diplomas are being awarded by the management and by several of the City Companies interested in different depart-

ments of the building industry. Also there is to be a number of conferences at which matters of interest to the architectural profession and the building trades will be discussed.

Of the 300 and more exhibits, but few have a direct connection with the gas industry, which, however, is well represented in different branches of several firms.

Gas Cooking and Heating.

Close by the main entrance to the exhibition the visitor comes upon the exhibit of the Davis Gas-Stove Company, Ltd., whose stand is so arranged as to enable them to make a convincing display, in operation, of many of their specialities, suitable for both large and small houses. Here one sees different forms of the "Alpine" high-efficiency gas-range—which is made in five sizes, with burners of the new Davis type, giving a short, sharp flame. Splash plates prevent grease getting into the oven burners, and the hotplate burners are protected from falling grease by the position of the jets. The mounting of the stove on stands or legs is a convenience that is now very generally appreciated. The "Alpine" extended range will be the envy of every housewife who sees it and who does not happen already to be possessed of a luxury so great as this style of gas-cooker represents. It is made to fit into an ordinary kitchen-range recess. It embodies the same excellent constructional features as the vertical form just mentioned, but the double-cased oven and the hotplate are situated side by side, and are mounted on a stand. The hotplate is equipped with boiling burners only. Grilling is performed in a special grill chamber beneath the oven—both grill chamber and oven being served by an economical revolving burner. The oven door (and that of the hot closet, if included with the stove) is fitted externally with a white-enamelled tile-pattern panel. The same clean and attractive finish is given to the sides of the oven and hot closet, and to the back plate of the plate rack. These extended "Alpine" ranges are shown in sizes suitable for families of five, seven, and nine. Some very handsome gas-grates have been fitted on the stand, including the latest pattern of Chinese tiles, with a "Nautilus" dog grate in armour-bright finish, and a new design of mantel-piece, with cigar cabinets on either side of the upper part. Davis "Rubston" gas-fireplaces consist of a gas-fire fitted with surrounds of "Rubston"—a material which resembles red bricks, and, while costing much less, is equal in appearance and durability. The special process by which "Rubston" is made is the result of a successful effort to produce a substance durable in colour, completely fire-resisting, capable of being easily cleaned with a wet cloth, and at the same time inexpensive. The "Rubston" set in action on the stand, along with the "Nautilus" cast-concrete gas-flue blocks, is an excellent example of the best gas-fire work. The firm show also many other of their particular appliances. In geysers there are the "Clover," the "Rose," and the "Shamrock"—representative of the firm's latest patterns. Then there are the "Crystal" gas-iron, containing an economical burner; the "Garba" portable gas-heater, with a maximum consumption of 5 c.ft. per hour—a brilliant little copper bowl with incandescent mantle, which immediately won a way for itself into home and office; the Nautilus "Blighty" washer, a saver of time and money; gas-heated coppers and tea urns; the "Sentry" coke-boiler, &c.

A range of the "Holborn," "Caroba," and "Liverpool" gas-cookers is shown by Messrs. Cakebread, Robey, & Co., Ltd., of Caroba Works, Wood Green, London, N. The "Liverpool" pattern has been designed to meet the demand for a reliable and economical low-priced cooker, and is, with its small maintenance cost, particularly suitable for small houses and bungalows. All three patterns are fitted with high-efficiency burners, and the taps are at the front of the hotplate. The burners are easily removable for cleaning purposes. They are to be seen fitted with the now popular white-panelled oven door. Coke boilers of various kinds are supplied by the firm.

Anti-Waste Appliances, Ltd, of No. 16-17, Pall Mall, London, S.W., draw attention to their coal and gas cooking and heating apparatus. The gas-cookers are designed with particular regard to economy, convenience, and cleanliness, while high-grade construction and finish are claimed for them. The ovens are fitted with falling doors, and are double lined, the heating being effected between the inner and the outer walls. The gas-taps controlling the ovens are provided with an automatic locking device, which prevents the gas being accidentally turned on when the oven is not in use. A special hotplate burner is offered which the firm say enables "an economy up to 30 p.ct. in gas consumption to be effected." If this economy of 30 p.ct. in consumption is as compared with the burner which would ordinarily be fitted to the "Anti-Waste" ranges, certainly the "Anti-Waste" double burner must be well worth the 1s. 6d. additional which is asked for it. These burners are said to be so constructed that the correct amount of air is admitted for the complete combustion of the gas, whether the tap be full on or in the position for minimum flame. This is accomplished by having a small ring flame within the larger one, both being controlled by the same tap, which enables the correct amount of air to be admitted for any gas consumption between the maximum and minimum of the burners. The hotplates are fitted with extension plates. These cookers are made in varying sizes, and with one or more ovens. There is an "Anti-Waste" combined coal and gas range, designed for houses where space in the kitchen is restricted. A hot-water circulator can be supplied for heating by the coal fire. "Anti-Waste" hotplates can be had apart from the ovens. "Anti-Waste" gas-radiators are also offered, with the announcement that they are very efficient and odourless, owing to the special burners which effect complete combustion. The gas consumption under full heat is about 8 c.ft. per hour per pair of pipes.

A point is made by the Carron Company, of Carron, Stirlingshire, of their gas appliances, which include cookers, hotplates, grillers, boiling burners, &c. Several of the firm's cookers are provided with extra wide hotplates. They also supply a combined gas-heated roasting oven and hotplate on stand.

The Falkirk Iron Company, Ltd., of Craven House, Kingsway, London, W.C., exhibit the "Smoothtop" patent gas-range, which is made in three sizes, and has ovens fitted with fall-down doors, balanced with compensating springs, and provided with heat-proof handles. "A single burner," it is said, "keeps the whole dinner hot."

Hot Water Supply.

What can be done in accordance with most approved practice in connection with gas apparatus for domestic hot-water supply and heating purposes is shown by Mr. Thomas Potterton, of Cavendish Works, Ravenswood Road, Balham, London, S.W., whose exhibit comprises a general display of the latest types of "Victor" boilers and complete systems, together with various forms of domestic coke boilers and a "Regulus III." cooker (as supplied on hire by the Brentford Gas Company) as examples of combined equipment. The latter will make a strong appeal to architects on the look-out for improved conditions. There are also new and improved forms of towel driers, &c. The "H" series "Victor" boiler, No. 92 size, is applied to demonstration purposes on the hot-water supply section of the exhibit. This heater embodies all the factors of importance in boiler design—automatic control of the heating effect, lightness, and easy maintenance—with low cost. Like all "Victor" boilers, it is of sectional construction, by which complete control of the products of combustion is obtained, and likewise the necessary ratio of heating surface essential to the production of the requisite circulating temperature. Another section of the working portion of the exhibit is a "D" series No. 20 boiler applied as an independent unit for working a series of radiators upon the low-pressure hot-water system, which is eminently suitable for offices, halls, garages, and other duties of moderate proportion. It is controlled with an air thermostat of the special type introduced by this firm, and demonstrates the great utility of gas in maintaining a satisfactory temperature in living rooms and for various manufacturing processes. There is also to be seen complete apparatus in the form of a No. 192 set with single-unit boiler and No. 292 set with twin boilers, each with storage in proportion. These provide examples of installation for larger requirements. Other examples include the self-contained portable sets largely adopted for housing estates, &c. A system is shown for the treatment of water to eliminate hardness, iron, or other impurities.

Ewart's well-known geysers are displayed both in action and ready for inspection. There are large and small, "sealed" and "open." Of "sealed" types, attention may be drawn to the "Victor" and "Lightning" series. The former is designed more particularly to meet the demand for a cheap and reliable geyser. The "Lightning" is made throughout of stout hardened copper, and a constant supply of boiling water may be obtained in one minute. A hot bath can be had in five, ten, or fifteen minutes, according to the size of the geyser. The "Royal" geyser, constructed on the "open" system, is suitable for heating water for bathing and washing purposes only. It is particularly adapted for districts where the water is hard, as it is impossible for the deposit to interfere with the efficiency of the geyser. Ewart's "Califont" has a wide reputation as an independent, self-controlled, instantaneous water heater, capable of supplying immediately hot water to one or more taps, or throughout an entire house. It is operated merely by the opening and closing of the hot-water taps, and the gas is only on at full power while hot water is running.

The "Clarkhill" is an automatic, fool-proof, instantaneous water heater, specially designed to supply an unlimited quantity of really hot water to as many taps as may be required all over the building. It delivers hot water instantly at the same pressure as that of the cold main supply, and can therefore be fixed in any convenient part of the premises. There is a by-pass which cannot ignite the gas at the burners unless water is actually being drawn off. The heater, which is tested to withstand a water pressure of over 330 lbs. per sq. in., is made entirely of copper and heavily nickelled brass—with the exception of the special galvanized-iron interior heat-retaining jacket. The operating valves and seatings are made of metal throughout. This water heater is supplied by Messrs. Clarkhills, Ltd., No. 27, Old Bond Street, London, W.

The "Pollard" portable water heater, exhibited by the Pollard Water Heater Company, of No. 108, Charterhouse Chambers, Charterhouse Square, London, E.C., is an appliance for which simplicity in construction and use is claimed. It has been designed with a view to economy and the saving of labour. As to economy in consumption, it is said that it can be run continuously for twenty minutes at a cost of 1d. for gas, but the price at which gas is taken for this calculation is not stated. Again, on the point of economy, it is pointed out that it "requires no expensive fitting, but can be connected by rubber tubing to existing gas and water supplies." With regard to simplicity, "it is absolutely fool-proof, and cannot possibly explode. It has no complicated parts or valves to get out of order, and it is not injured should the gas inadvertently be lit before the water is turned on. There are

no tubes whatever in its construction, and the interior can be removed, cleaned, and replaced by any unskilled person in a few minutes." Where no gas is available, this portable heater can be supplied fitted with a wickless paraffin oil stove.

Mention has on previous occasions been made in the "JOURNAL" of the specialities of the Hurry Water Heater Company, of No. 39, Broad Street, Birmingham. "Hurry" furnaces, or coppers, can be had for either gas heating or coal heating, and with or without bath connection. The cold-water supply to the furnace and hot-water overflow to the bath are shown. A tap on the furnace is for drawing-off dirty water after washing day. The copper may then be kept full of water the remaining part of the week, for bath and domestic purposes, the hot water being obtained through the overflow pipe. The bath may be fitted in a separate room, but on the same level. Without in any way denying the justice of the claims to efficiency of the "Hurry" copper, or furnace (a circulating hot-water system, giving repeat hot baths in quick succession), it may be said that "An Important Architect" must have had a peculiarly unfortunate experience with present-day geysers, for he writes of the "Hurry" patent furnaces: "I prefer them to the ordinary geyser. Really hot water can be drawn off, instead of the usual dribble."

New Geysers, Ltd., of No. 200, City Road, London, E.C., offer a number of patterns, to meet large and small requirements for hot water, of Barralet's geysers. The latest developments—the "Reliafont"—provide an entirely automatic instantaneous machine supplying hot water to any number of taps at any distance. The opening or closing of any tap causes the automatic valve to operate and correspondingly open or shut the gas supply. Apart from the pilot jet, no gas is consumed except when hot water is flowing. Thus the geyser need not be fitted in the bathroom, thereby avoiding all possible difficulties with ventilation, gas service, space, &c. There is also the "Two-Way," which is non-automatic, for serving two points only—say, the sink and the bath on a higher level. When the tap over the sink is closed, the hot water passes upwards and flows into the bath. This latter supply pipe acts as an expansion pipe, and must be left open without tap.

More geysers and water heaters generally are to be found on the stand of Messrs. Fenlon and Son (incorporating Messrs. G. Shrewsbury & Co.), of No. 8, Tudor Street, London, E.C. As examples may be quoted the "C. C. Fleet" and the "Bantam" geysers. The former, made in stout hardened copper, is intended to meet the demand for an efficient low-priced "sealed" geyser. It has a detachable interior, easily removed for cleaning, inspection, or repair. The "Bantam" is for lavatory purposes, and will heat about a gallon of water a minute. There is at work the "C. C. Fleet" combination circulator and storage. In other directions, one notices gas-boilers for greenhouses and garages, and gas-radiators. There is also the "Ludgate" gas-heated hot-water towel rail. This is self-contained and easily fixed, requiring only a connection with the nearest small gas supply. The gas consumption is about 3 c.ft. per hour. After the towel rail is once filled with water, it requires no attention beyond the occasional addition of a little water, to take the place of that evaporated.

Some Other Features.

There is evidence throughout the exhibition of the growing popularity of coke-burning boilers. In this connection (in addition to the "Sentry," already referred to), mention may be made of the "Glow Worm" boiler exhibited by Mr. O. Bruster, of No. 4, Lloyds Avenue, London, E.C. This has been specially designed to meet the ever-growing demand for a small and inexpensive boiler to provide a constant supply of hot water more economically than has been obtained in the past by the use of the ordinary kitchen range. It is of pleasing appearance, and besides burning broken coke or anthracite it will consume household refuse.

British Uralite and Cellactite Works, of Lincoln House, High Holborn, London, W.C., show, with other specialities, their "Urastone" flue pipes and fittings, which are non-corrosible and extremely durable. It is claimed that they effectively disperse products of combustion and minimize condensation troubles; and that, bricked into walls, they effect considerable economy in brickwork, since no chimney stacks or breasts are required.

"Permac" rustless jointing material in powder form is to be found on the stand of Messrs. Thomas and Bishop, Ltd., of No. 37, Tabernacle Street, London, E.C. This is suitable for joints on domestic boilers, hot-water radiators, &c.; it also resists toluole, benzole, oil, and acid. The firm shows, in addition, an apparatus for oil filtration.

Illuminating Engineering Society.—A meeting of the Society will be held at the Royal Society of Arts, Adelphi, on April 28, when a discussion on "Some Problems in the Lighting of Textile Mills" will be opened by Mr. E. L. Oughton and Mr. P. J. Waldram.

Trueman Wood Lecture at the Society of Arts.—Readers will regret to learn that, in consequence of illness, Prof. C. Vernon Boys, F.R.S., will be unable to deliver the Trueman Wood Lecture, at the Royal Society of Arts, on "Calorimetry," which he had arranged to give on Wednesday, May 21. His place will be taken by Sir William J. Pope, K.B.E., D.Sc., F.R.S., Professor of Chemistry in the University of Cambridge, who has chosen as his subject, "The Outlook in Chemistry."

PULVERIZED FUEL FIRING.

The "Lopulco" System.

The importance of utilizing the powdered coal which has hitherto been regarded as a waste product was emphasized last Thursday week at the Hotel Cecil; the occasion being a complimentary dinner by Messrs. Vickers and International Combustion Engineering, Ltd., to three United States power-station engineers—Mr. C. W. E. Clarke, M.I.Mech.E., A.S.M.E., Mr. F. H. Rosencrants, A.S.M.E., and Colonel E. M'Cullough M.Am.Soc.C.E.

It must be mentioned here that Messrs. Vickers and International Combustion Engineering, Ltd., of Africa House, Kingsway, W.C. 2, design and supply complete boiler-house plants, from the handling of raw coal to the delivery of steam to the prime movers, and their works at Barrow-in-Furness are equipped for making pulverized fuel plants and boilers of the largest sizes. They are interested in the "Lopulco" plant for powdered coal, which was first used for steam locomotives in 1912, and for electric power stations in 1915. Its use has since extended, in 30 large electric power stations, to 130 boilers, having 2 million sq. ft. of heating surface. In addition, there are many smaller installations; and the growth of the system is gathered from the fact that already the rate of burning fuel in "Lopulco" apparatus has reached about 3½ million tons per annum, and plants are being added at an ever-increasing rate. The system comprises a number of patented engineering devices to carry out the following operations: Dry the raw fuel by means of waste heat, in a gravity louvre-type drier which has no moving parts; pulverize the fuel to required fineness by means of a "Raymond" roller mill, and remove the powder by air separation; supply the fuel at required speeds to suit any rate of evaporation, by means of "Lopulco" feeders. Thoroughly mix the pulverized fuel with a minimum amount of air to carry all of it to the burners; burn the fuel and air in "Lopulco" burners, fitted in the arch of a specially constructed combustion chamber; preheat the secondary air by passing it through ducts in the walls of the combustion chamber, thereby cooling the brickwork; induce currents of secondary air through adjustable ports in the walls of the chamber so that it mingles effectively with the flames; project the flames with such direction and velocity that the hottest zone is kept well away from the brickwork and the rising gases have ample time to complete combustion before reaching the boiler tubes; and cool the bottom of the combustion chamber by means of a "Lopulco" water screen connected to the boiler, thus preventing at all loads any fusion of the ash particles. The "Raymond" roller pulverizer, with air separation, has been adopted for the "Lopulco" system because it grinds a very uniform product with a minimum amount of power.

Sir Trevor Dawson, Bart., who presided at the dinner already referred to, pointed out that a vast amount of powdered coal which accumulated in the operation of taking the coal from the mines was to-day almost entirely a waste product; but by utilizing this invention which Mr. G. E. Learnard had brought them to this country—and which had been thoroughly tested in the United States, France, Belgium, and, he thought, Germany—it would be possible to employ this waste product as though it were the best coal. By the use of powdered fuel, a new means of creating cheap power had been provided. Subsequently Mr. George Usher declared that 25 p.ct. of the coal hewn at the present time in Great Britain never saw the light of day; but the advent of pulverized fuel rendered this coal a commercial product. Mr. J. Horace Bowden, M.Inst.E.E., said he went to the United States very sceptical, but came back absolutely convinced that the claims made on behalf of pulverized fuel could be substantiated. Pulverized fuel had come to stay. Mr. Frank Hodges, P.C., M.P., Civil Lord of the Admiralty, expressed the opinion that all that was wanted in this country was a higher measure of what he would call "citizen co-operation." Great Britain possessed huge coal supplies, and with the fullest technical knowledge at their disposal every ounce of this coal, no matter what its dimensions, could be utilized for the general well-being of the country. The time would come, he firmly believed, when they would take out of the pits every bit of the coal. The very fact of the fine coal being left in the pits had cost thousands of lives. Sir Trevor Dawson added his conviction that the invention would be of great importance to this country.

Census of Production Act, 1906.—In accordance with section 9 (1) of the Census of Production Act, 1906, the President of the Board of Trade has appointed the following gentlemen, together with officials of the Home Office and the Board of Trade, to be a Committee for the purpose of advising the Board as to the preparation of the forms and instructions necessary for the taking of the census, and the making of any rules under that Act: Mr. T. J. Arnold, J.P., Sir Arthur Balfour, K.B.E., Sir Hugh Bell, Bart., C.B., Prof. A. L. Bowley, Mr. Stephen Easten, O.B.E., J.P., Sir Henry J. Gibson, K.C.B., Mr. Kenneth Lee, Prof. D. H. M'Gregor, Mr. R. C. Perry, C.B.E., Sir W. Peter Rylands, and Mr. Arthur Shaw. The Committee will hold their first meeting at an early date. The Secretary of the Committee is Mr. G. A. G. Stanley, Board of Trade, Great George Street, S.W. 1, to whom all communications should be addressed.

A LABOUR-SAVING HOPPER-WAGON.

The present state of industry and the high cost of labour has led to an increased use of mechanical methods for handling materials so as to reduce the cost and time occupied, more particularly in unloading. For this purpose the hopper wagon has been introduced to enable the contents of a wagon to be released and discharged rapidly with a minimum of labour. Such wagons are eminently suitable for handling the products and materials obtained from, and employed in the manufacture of gas at, large gas-works. Below is given a brief description of an exceedingly efficient design of hopper wagon which has been invented by Mr. W. J. Lanegan, mainly as a result of his experience at the works of one of the largest London gas companies.

The invention has been given an extensive trial under ordinary working conditions, with very effective results. It has been found to be entirely reliable in practice, and enables the whole of the

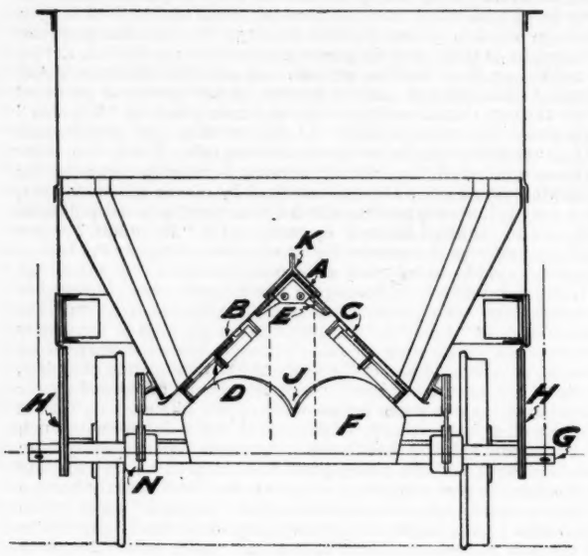


Fig. 1.

contents of the wagon rapidly to be discharged without the employment of any labour for wagon trimming; only one man being necessary for the purpose of actuating the hopper doors, which are provided with suitable mechanism to enable them to be easily released and re-closed from the side of the wagon. A special design of automatic gear has also been produced which enables the wagons to be discharged automatically by devices placed in the track and adapted to be raised so as to engage the door mechanism of the hopper wagon as it passes along the track. These devices may be controlled by a lever at the side of the track substantially in the same manner as points or signals are controlled by a signalman upon the railway.

The feature of greatest importance in the design of a hopper

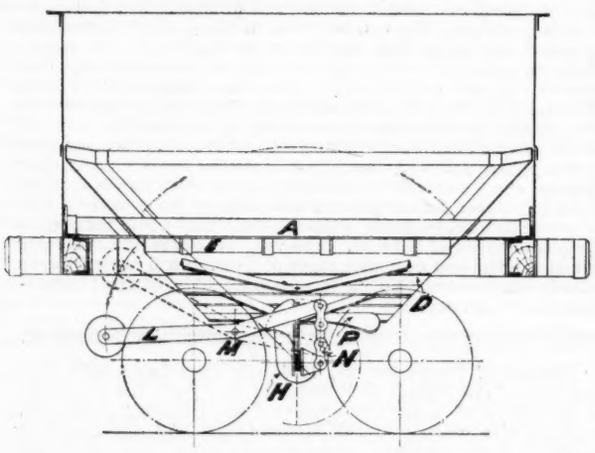


Fig. 2.

wagon, to enable efficient operation, is the arrangement of the discharge opening—of sufficient size to allow the material to discharge freely—and of the doors which normally close this opening, so that they will not obstruct the free discharge of the material when they are in the open position. A glance at the section of the wagon (fig. 1) will show how effective the discharge arrangements are in this design. The doors B and C are mounted so as to drop instantly clear away from the material when released, allowing clean discharge even with such materials as wet plugger breeze. The time taken in discharging the latter was 2 minutes against 15 with a wagon of equal size of ordinary design.

The doors are stiffened as shown at D and hung vertically from hinges E from the longitudinal iron A, which adds considerably to the strength of the wagon. Opening and closing of the doors is carried out by a saddle F formed with a lip J for sliding between the doors and forcing them into position. The saddle is mounted on a transverse shaft G supported by brackets hung from the sides of the wagon, and worked with either a spanner or tommy bar inserted in the end of the shaft. The locking is completed by allowing the saddle to revolve till it meets the stops on the bars P—slightly past the vertical—where it is held in position by the lever L mounted on the bracket M. The shorter end of the lever is connected by links to the shaft, and the longer end is counter-balanced to give easy working.

The design illustrated here is, of course, typical, and may be applied with advantage to any desired proportion and design of wagon. In the construction shown, it will be noticed that no expensive gear is required; the work being a straightforward plater's and smith's job. There are no parts liable to get out of order with even rough usage. For heavy wagons, a system of opening and closing the doors automatically from the track may be employed. It is worked similarly to a point switch, and consists of a hand lever at the track side, which raises a device from an inoperative horizontal position to a vertical plane, to engage the door mechanism. By this method the doors can be opened, and afterwards securely locked in either direction of travel.

The various features of this new wagon design and apparatus are protected by patents, and fuller particulars can be obtained from the patentee, Mr. W. J. Lanegan, of 7, Monteagle Avenue, Barking, Essex. Mr. Lanegan also has a most effective working model of the automatic discharge mechanism, which he will be glad to demonstrate to any interested parties.

THE UTILIZATION OF WASTE FUEL.

The "Bennis" Sprinkler Stoker.

Though coal is often referred to by the rather hackneyed term of "black diamonds," its use, at any rate prior to 1914, indicated anything but the careful regard usually associated with an article of value. Of recent years, however, increased attention has been, and continues to be, given to the proper and effective use of this precious mineral, and, in connection with it, to the closely related problems of efficient and economical steam raising, and of mechanical handling. Of the coal used in Great Britain, 90 million tons per annum, or 48 p.ct. of the total, are used for steam raising, of which a considerable proportion is employed for this purpose in the collieries themselves. It is by no means unusual to find that the fuel consumption in a colliery is as much as 10 p.ct., or more, of the output. The Coal Control Board in 1916 calculated that the average total efficiency of boiler plants in this country was then about 60 p.ct. When it is remembered that in modern boiler-house practice an efficiency of from 75 to 80 p.ct. is fully practicable, the need for improvement is obvious. In colliery practice, the great advantage of mechanical stokers is the ease with which they can burn low-quality coals successfully. Under modern conditions, suggest Messrs. E. Bennis & Co., Ltd., of No. 28, Victoria Street, S.W. 1, there is no reason why the piles of fuel which disfigure the colliery districts should not entirely disappear, and, by being used in the boiler furnace, release the better coals for a more worthy purpose.

As a typical example of what can be done, this firm, in a booklet entitled "Diamonds and Dust," refer to the case of a Durham colliery which installed "Bennis" machine stokers and a complete handling plant. The steam plant consists of six Lancashire boilers, now fitted with sprinkler stokers and compressed-air furnaces manufactured by the firm in question. Three classes of fuel were used—cannel coal mixed with shale, belt pickings thrown away as useless, and washery refuse mixed with a little cannel. With these fuels it was found possible to produce from 4600 to 6300 lbs. of steam per hour from a Lancashire boiler 8 ft. by 30 ft., thus not only avoiding the consumption of a better-class material, but making profitable use of what had been only an encumbrance. An exhaustive test of these fuels yielded the following figures.

Class of Fuel Burnt.	Cannel Coal.	Belt Pickings.	Cannel Coal mixed with Washery Refuse.
Fuel burnt per hour (lbs.)	1024	1269	1045
Fuel burnt per sq. ft. of grate per hour (lbs.)	29·4	30·9	25·5
Percentage of ash and clinker	18·6	66·2	"
Water evaporated from and at 212° Fahr. per lb. of fuel (lbs.)	5·28	3·65	5·03
Water evaporation from and at 212° Fahr. per hour (lbs.)	6365	4632	5260
Average temperature of feed water entering boilers (° Fahr.)	150	167	160
Average steam pressure by gauge (lbs. per sq. in.)	66	73	72

These figures are sufficient commentary on the performance of the "Bennis" furnaces when dealing with this class of fuel.

MANCHESTER AND DISTRICT JUNIOR GAS ASSOCIATION.

Annual Meeting.

The Annual Meeting of the Association was held at the Grand Hotel, Manchester, on April 5—Mr. J. H. Clegg (Burnley) presiding.

The report was formally approved after having been read by the Secretary (Mr. J. Alsop). The number of members on the books last year was 214. Since then twenty-one members have been enrolled, five have resigned, seven have ceased to be members by operation of rule 4, and four have left the district, leaving the membership at 219—an increase of five.

In addition to the Presidential Address, the following papers were read during the year: "The Thermal Efficiency Factor in Gas Manufacture," by Mr. E. Crowther, M.Eng., Assoc.M. Inst.C.E. (Stoke-on-Trent); "Notes on Waste-Heat Boilers," by Mr. C. H. Bamber, B.Sc. (Bolton); and "Naphthalene," by Mr. H. P. Lupton, B.Sc., A.I.C. (Liverpool).

Visits were paid to the following works: Burnley Gas-Works; the Great Harwood Gas-Works; Messrs. Hardman and Holden's, Tar Distillers, of Manchester; Messrs. Galloways, Ltd., Boiler Makers, &c., Manchester; The Stanton Iron Works, near Nottingham; and Messrs. Hans Renold's, of Burnage, near Manchester. A ladies' day took the form of a picnic to Chester.

The report also gave particulars about the education question that had been raised at the last Joint Council meeting. The prize for the best paper given during the session was awarded by the Council to Mr. Bamber. The prize was given by Mr. J. Berry (Oldham).

Mr. Briggs (Hyde) moved the vote of thanks to the Council for their work during the session. This was seconded by Mr. Prince (Heywood).

Mr. A. Dixon, Assoc.M.Inst.C.E. (Lancaster) replied to the vote.

Election of Officers.

The following officers were elected for the next session.

President.—Mr. H. E. Stone, A.M.I.Mech.E. (Birkenhead).
Senior Vice-President.—Mr. J. H. Clegg (Burnley).
Junior Vice-President.—Mr. J. H. Maynes, Assoc.M.Inst.C.E. (Bolton).
Hon. Secretary.—Mr. J. Alsop (Bolton).
Hon. Treasurer.—Mr. D. T. Livesey (Stretford).
Auditor.—Mr. F. Dean (Altrincham).

The Hon. Secretary (Mr. J. Alsop) read the apologies of the guests who had not been able to be present that afternoon. These were from Mr. Harrison (Engineer of the Great Harwood Gas-Works), Mr. Leather (late Gas Engineer of the Burnley Gas Department), and Mr. Frith (President of the Manchester and District Institution of Gas Engineers).

Presentation.

Mr. J. Berry presented to Mr. Bamber a case of cutlery, as the prize for the best paper given during the session. He remarked upon the difficulty of judging the papers, and said he was glad he was not the one who made the decision. He left that with the Council.

Mr. Bamber thanked Mr. Berry for the gift.

The Education Scheme.

Mr. J. Bridge, Elland, was invited by the President to speak on the Education Scheme.

Mr. Bridge, who is one of the two representatives of the Junior Gas Associations on the Advisory Committee, outlined the scheme, and mentioned that a considerable number of students throughout the country would be sitting for the Institution Examinations which would be held next month. The Yorkshire Junior Gas Association were lending support to the scheme. At Halifax alone there would be fourteen students sitting for the examinations. The Council of the Manchester Junior Gas Association in the past had taken an active part in evolving the Education Scheme—perhaps a more active part than any other association; and he would not like to think the Association were lacking now in enthusiasm and support. There had been difficulty in getting technical authorities to submit courses for approval; but he could assure the members that Mr. Hole, the Organizing Secretary, would, with the assistance of the Board of Education, do all possible to have classes provided in convenient centres. Mr. Bridge paid a high tribute of appreciation to the valuable services which were so freely given by Mr. F. W. Goodenough, the Chairman of the Advisory Committee. Everyone connected with the gas industry, and particularly the Junior Gas Associations, owed a deep debt of gratitude to Mr. Goodenough and Mr. Hole.

Mr. S. Tagg (President of the Institution of Gas Engineers), who was present in the dual capacity of guest and of member of the Association, with which he has been connected for the last twenty years, spoke upon the work the Institution had done in connection with the Education Scheme, and offered a few words of encouragement to those who had their doubts as to one or two points in the scheme. He explained that, after they had made a fair start, most of the little difficulties would pass away. They would be in a better position to deal with certain matters after they had seen the results of the Examinations.

Members of Council.

The ballot papers having been counted and tabulated, the President announced that the four new members of the Council were: Mr. F. B. Small (Liverpool), Mr. C. H. Bamber (Bolton), Mr. H. C. Applebee (Manchester), and Mr. W. H. Battersby (Bury).

Mr. J. Alsop moved a vote of thanks to the scrutineers for the work of tabulation.

Presentation to the Late Treasurer.

The President presented Mr. J. Robinson, of Altrincham, with an armchair and a gold "eversharp" pencil, which had been subscribed for by the members as a mark of esteem for the twelve years' services he had rendered to the Association.

Mr. Robinson suitably responded to the presentation.

Presentation to the Hon. Secretary.

Mr. Eustace Parker, J.P., handed to the Secretary (Mr. J. Alsop, of Bolton) a gold-plated silver medal. He said how much he appreciated his connection with the Association. He was well aware of the work done by the Secretary, and felt that he would like to show his own personal appreciation of Mr. Alsop's work for the Association, spreading over a period of years. He hoped Mr. Alsop would live a long time to wear the medal.

The medal has a beautiful enamelled centre, showing a lar g up-to-date gasholder, with the name of the Association and that of the recipient round it. On the reverse is inscribed: "For long and faithful service. Presented by Eustace Parker, J.P., in appreciation."

Mr. J. Alsop, in acknowledging the presentation, said he was much indebted to Mr. Parker for this signal mark of appreciation of his services. He took the opportunity of thanking the members for their hearty support given to him in the performance of his duties.

The following paper was then read:

POSSIBILITIES OF FUTURE CARBONIZATION.

By H. B. Knowles, of Lancaster.

I think the future depends to a large extent on the use of oxygen in gas production. Some will say that the theories advanced are impracticable, especially after reading that Mr. T. C. Finlayson, of Messrs. Woodall, Duckham & Co., after long research work, has decided that cheap oxygen, with present-day methods of manufacture, is unattainable.

Supposing cheap oxygen was available, let us consider its use in relation, first, to the producers of vertical retorts, chamber ovens, or horizontals. A properly-regulated producer, supplied with oxygen at a constant pressure and volume, would give a perfect gas in regard to both volume and quality. Probably a larger amount of clinker would be formed in the furnace; but this could be reduced, and the temperature kept at a correct standard, by judicious steaming. With outside producers as used on some works, better results would accrue than in the case of ordinary inside producers (attached to the beds). The nitrogen content of the gas would be reduced from 50 p.ct. to not more than 1 or 2 p.ct., the hydrogen and carbon monoxide contents would be increased, and the calorific value of the gas would be somewhere near 350 B.Th.U. per c.ft. Added to this, mechanical clinkering grates could be installed, and constant depth of fuel more easily attained by automatic-feed apparatus.

At the present time, an outside producer supplies some coke-oven and bye-products plants with a low calorific value gas, by which the ovens are heated, leaving all the high calorific value gas from the coal in the ovens for other purposes—such as town's lighting, power, &c.; thereby saving on regenerative ovens 50 p.ct. of good gas hitherto used for firing.

Suppose the coke-oven practice of gaseous firing was adopted in gas-works processes, along with oxygen, instead of air, draught. A regular and fairly high calorific value gas of uniform volume and quality would be available to heat the retorts. No cellarman would be required to remove clinker, and no furnaceman to prick the fires. A gas regulator would be required; but this work could be done by the stoker in place of filling up fires, especially if mechanical means of gas regulation were adopted. Though the above offers some inducement to do away with coke-fired furnaces to each bed of retorts, carbonization by external heat will never be the ideal method of gas manufacture. The refractory materials, and also the coal, are not ideal conductors of heat; and great thermal losses occur in keeping these at high temperatures. The ideal way appears to be to allow the oxygen to produce heat in the charge itself—*i.e.*, in some form of a total-gasification plant—such as the Tully plant, a water-gas plant, or an ordinary producer plant (similar to a Mond plant)—in which maximum thermal efficiency might be attained.

The reactions in the ordinary producer plant, using coke and oxygen, are as follows:

$$CO_2 + C = 2CO \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$2C + O_2 = 2CO \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The latter reaction is exothermic. In order to keep down the temperature in the producer, some of this heat can be utilized in splitting-up steam. This steam may react on the carbon in the following ways:

$$C + H_2O = CO + H_2 \quad . \quad . \quad . \quad (3)$$

$$C + 2H_2O = CO_2 + 2H_2 \quad . \quad . \quad . \quad (4)$$

These actions are endothermic. Above 1832° Fahr. reaction (3) is more likely to occur.

Looking at these four equations and treating the matter entirely on a theoretical basis—*i.e.*, assuming the coke to be pure carbon—the equations required for our purpose, to attain the best results, are (2) and (3), since these give us a richer gas, and No. (3) reaction absorbs a greater amount of heat, and thus tends to keep the heat zone in the producer at a correct working temperature. The proportion of steam required can be determined from these equations; but in practice the theoretical amount is affected by the nature and composition of the fuel used. The weight of water required per pound of carbon equals approximately 0·63 lb. The gases generated will be in the following proportions: 1241 c.ft. of carbon monoxide, 526 c.ft. of hydrogen. This gives a gas of a calorific value of 328 B.Th.U. (gross). The oxygen required for the 1767 c.ft. of the above gas would be 357 c.ft. The make per ton of carbon carbonized in such a manner would be 95,400 c.ft., and would require 19,300 c.ft. of oxygen at 100 p.ct. efficiency. Unfortunately, owing to heat being lost by conduction, radiation, and in the ashes, &c., the efficiency would probably be 80 p.ct.

In the Sixth Report of the Research Sub-Committee of the Institution of Gas Engineers, the efficiency of water-gas production with waste-heat boilers was given as 56 p.ct.

According to Prof. J. W. Cobb and Mr. H. J. Hodsman, in a paper submitted to the Institution of Gas Engineers in 1920, the use of oxygen in complete gasification of coal would result in a make of 61,700 c.ft. of gas of a calorific value of 352 B.Th.U. per ton of coal carbonized. The analysis of the gas would be:

	P.Ct.
Carbon dioxide	0·33
Illuminants	0 35
Oxygen	0·06
Carbon monoxide	63·20
Methane	4·26
Hydrogen	30·80
Nitrogen	1 00
	100·00

Prof. Tour and Mr. E. W. Jefferies, of America, have given practically the same results.

A gas of 328 B.Th.U. (gross) is too low to be used without enrichment. Provided enrichment could be carried out, and any calorific value of gas obtained, the use of oxygen in a producer plant would open out a great vista to the gas engineer.

Capital costs for a gas-works would be low in comparison with to-day's costs. No large outlay in retort-houses would be needed, and sudden demands could be dealt with easily. Labour charges also would be greatly reduced, and coal-handling charges decreased. The ground space for a works would be small.

The elimination of bye-products by such a process would not be acceptable to all. However, a combination of two processes of gas manufacture could be easily adapted. The enrichment of the producer gas could be carried out by mixing with a rich coal gas.

Perhaps the best method of enrichment is by low-temperature gas. Suppose we take a low-temperature gas having (say) the following composition:

	P.Ct.
CO_2	1·7
CO	6·1
O_2	0·3
C_nH_m	4·1
CH_4	39·51
H_2	45·21
N_2	3·08
	100·00

Make per ton of coal carbonized, 10,000 c.ft. of 700 B.Th.U. (gross) value.

From the oxygen producer plant a make of 76,000 c.ft. of 328 B.Th.U. (gross) per ton may be obtained with a composition as follows:

	P.Ct.
CO	70·00
H_2	30·00

By mixing these two gases, any calorific value can be obtained. A gas of 450 B.Th.U. would have the following composition:

	P.Ct.
CO_2	0·5
CO	49·2
O_2	0·1
C_nH_m	1 3
CH_4	12·7
H_2	35·2
N_2	1·0
	100·00

The make per ton would be approximately 24,000 c.ft.

A works run on these lines would be a great help in the smoke abatement campaign, for, besides providing gas for lighting, cooking, heating, and industrial purposes at a cheap rate, a smokeless fuel, in place of household coal, boiler coal, or industrial coal, would be provided, as far as can be seen, at a cheaper price than coal.

Also, conservation of coal would be given a decided fillip, for there would be less trouble in the selection of coals for carbonization in producer plants than is at present the case.

There are many other ways in which oxygen could be used to advantage. This paper has dealt with the manufacturing side of gas-works, but wonderful results could be achieved on the distribution side. There seems no reason why oxygen could not be used at the consumers' burners. Much better results would be obtained, and perfectly combustible mixtures would be the general rule. If oxygen can be manufactured at 5d. per 1000 c.ft., great developments will take place in the gas industry.

Mr. Bridge moved, and Mr. Dixon seconded, a vote of thanks to the author for his paper.

The members then adjourned for dinner, after which they enjoyed a social evening. Special entertainers had been engaged, and a most pleasant evening was spent.

The guests of the evening were: Mr. Samuel Tagg (President of the Institution of Gas Engineers), the President, Secretary, and Vice-President of the Yorkshire Junior Gas Association, and Messrs. A. Johnson, Ashton, Miles, and Porteous.

SCOTTISH JUNIOR GAS ASSOCIATION.

(WESTERN DISTRICT.)

The Annual General Meeting of the Western District of the Association was held in the Royal Technical College, Glasgow, on Saturday afternoon, April 5—Mr. Andrew Walker (Kilbarchan), the President, in the chair.

Annual Report.

Mr. J. Murray (Hon. Secretary and Treasurer) submitted the annual report of the Council, which stated that the twentieth session had been very successful. Attendance at meetings, however, could be much improved, and the Council regretted to note that many members were present only at the visits. The total membership was now 345—a net increase of 40 during the session. The Council had elected Mr. James Dickson (Johnstone), Mr. A. S. Nisbet (Paisley), Mr. George Braidwood (Coatbridge), and Mr. James Dickson (Kirkintilloch) to honorary membership of the Association. For the best paper read during the session 1922-23 the adjudicators awarded equal firsts to Mr. James Hall for his paper on "Water Gas" and to Mr. Archd. Kay for his contribution on "Water Heating." Two prizes were awarded, one from an anonymous donor and the other from the Association. The Association were indebted to Mr. John M'Lusky for the invitation to the members to join with the staff in their weekly discussions on gas topics. They were also indebted to him for his prize for the best essay of criticism of the papers read and visits made last session. Mr. Duncan Melvin was awarded first prize, and Mr. James Brown second prize. The Council congratulated the following members on their promotion: Mr. A. Wylie, Glasgow, to Sales Superintendent, Sheffield; Mr. N. B. Thomson, Glasgow, to Assistant Manager, Skipton; Mr. J. Morrison, Glasgow, to Manager, Ballymena; Mr. A. B. Munro, Glasgow, to Showroom Manager, Burnley; and Mr. J. Graham, to District Superintendent, Kilmarnock. It had been decided again to issue the "Transactions" of the Eastern and Western Districts as a joint volume.

Mr. James Cubie (Glasgow) moved the adoption of the report, which was adopted.

The financial statement, which was next submitted, showed that the balance brought forward from the previous year amounted to £38, and that after meeting the expenditure of the past year there was a balance in hand of £85.

Office-Bearers.

The following office-bearers were elected:

President.—Mr. John M'Isaac, of Glasgow.

Vice-President.—Mr. James Gray, of Hamilton.

Hon. Secretary and Treasurer.—Mr. John Murray.

Members of Council.—Messrs. James Elder (Provan), James Graham (Kilmarnock), Alexander Shand (Falkirk), Wm. Hogg (Glasgow), and A. F. Sinclair (Greenock).

It was decided to give a trial to afternoon, instead of evening, meetings.

A Contribution to Wembley.

The President called attention to the exhibition to be held at Wembley this year, at which the gas industry would be making a special effort to bring before the notice of everyone in Britain the use of gas. He proposed that they send a subscription of five guineas to help on the good work, and to show that they wished it every success.

This was unanimously agreed to.

Mr. J. W. M'Lusky commended them for this enterprise and enthusiasm. He greatly admired their action in voting this subscription.

It was also agreed to present the Hon. Secretary with seven guineas, as some slight recognition of the way in which he had discharged his duties.

The President then introduced Mr. James Dickson, Gas Engineer and Manager at Johnstone, to deliver an address, from which the following are extracts. Mr. Dickson was one of those who helped to start the Junior Association in Scotland.

Address by Mr. James Dickson, of Johnstone.

Looking back on the earlier days of the Association, I think some of us had at least enough enthusiasm and faith in ourselves to attempt to turn certain phases of the world of gas manufacture and distribution upside down; but sufficient rope mercifully was denied. We do not, perhaps, begin to study the practical politics of the industry until we have some responsibility placed upon us—our first charge, for instance. We go on to study history—the history of the undertaking over whose fortunes we are called to preside. We do not see our ideal scheme, but a mass of things evolved over a period of years from the thoughts of those who have gone before. Probably this is not an uncommon experience. In any case we determine to settle down to do something that will impress the mark of our own individuality upon the undertaking; and in this way more history is written.

Your membership embraces those engaged in all departments of gas service, each with its own particular interests and experiences, each affecting the other, and all essentially concerned with the fund of that specialized knowledge which is most useful to you in order that you may be equipped to cope with your environment—to adapt yourself to it, or to change it—and thus render efficient service. The Junior Associations help to foster and train those faculties of keen observation, wise listening, reading, and debate so necessary for work dependent upon the use of methods applied to the nature of the materials handled, and an adequate knowledge of their physical and chemical properties. All this cannot be attained by study alone, but rather by a compounding of study with its application to the practical matters of everyday life—the happy medium lying between the knowledge gained from books and that gained from experience.

The improved methods and processes of gas supply within recent years make it difficult for one to keep always in the front line. In face of the best intention to plan well for the future, viewpoints quickly undergo modification. Think, for instance, of the difference in coal and coke storage area requirements, and in plant capacity, which the steaming of vertical retorts and blue-water gas dilution of horizontal-retort gas have brought about. Consider the difference in the volume of railway or other traffic in coal and coke, the market conditions applicable to the sale of secondary products, and the effect these have upon our ideas as to available storage accommodation for ammoniacal liquor, crude tar, and its distillates, all of which would now seem to require more ample storage facilities. Again, think of the ever-increasing business in the sale of gas-consuming appliances, and the need for greater facilities with which to undertake this work satisfactorily, and the effect that the consequent increase in gas sales, levelling-up the daily or hourly load, has had upon our ideas of storage accommodation for gas. These are only a very few points that occur to one as revealing the change in conditions which require to be met. Yet, with a wide outlook in planning, complication will be avoided, even though ample spacing of units is not possible to the extent one would desire. Probably not one gas engineer in a hundred has the opportunity of planning a works on a new site. Nevertheless, through the adoption of modern carbonizing methods and the successful handling and marketing of secondary products, economical use of the raw material is being made on works sites which have nothing specially to commend them.

The Production of Therms.

Plan to produce efficiently. Distribute and sell in order to produce yet more efficiently. The therm basis of charge provides the industry with the means for reducing to a common denominator the respective values of all commodities marketed as fuel. No matter whether gas is produced by means of horizontal or vertical retorts with or without diluent, or the coal is completely gasified, the process is carried out in order to produce a commodity which must compete with others. Under the therm basis, we have to consider the most efficient means by which therms can be produced and sold. Whatever system of carbonization is in use, everything is reduced to a matter of the best return that can be obtained selling the products under safeguards provided by the testing clauses of the Gas Regulation Act. As applied to undertakings working under the Burghs Gas Supply (Scotland) Act, 1878, it has been put forward, and not without some reason, that section 41 places Scottish municipal undertakings working under this Act in a different position from that occupied by sliding-scale or maximum-price company or corporation controlled works. The benefits which will follow from the sale of gas on a thermal basis by such undertakings may not at first sight appear so real as those given to consumers supplied by a company undertaking; but the principle is now firmly established by statute, it has stood the test of examination by a select Parliamentary Committee appointed by the Board of Trade, and its adoption by all statutory undertakings is requisite. Though its penetration into Scotland has been slow, it will soon be adopted by many municipally-owned undertakings, and, I venture to suggest, will be found a measure of prime importance to the industry.

The results on a therm-yield basis from horizontal retorts with or without water-gas dilution, compared with vertical-retort working, provide interesting comparisons; and I should like at this stage to put forward figures which have been obtained in Kirkintilloch from a mixture of the well-known coking triping in that district, cannel, and 20 p.ct. of secondary coals. The average calorific value of the coal in this mixture is not stated; but if values of 13,000 B.Th.U. per lb. for coal and coke, and 15,500 B.Th.U. for tar are taken, the therms are distributed as follows:

Horizontal Retorts.

Gas.	Coke.	Tar.	Total Yield.	Coal Estimate.	Efficiency.
					P.Ct.
60	156	18	234	291	80

Coke made, 10·75 cwt.; tar, 10·4 gallons; sulphate of ammonia, 28 lbs.

Horizontal Retorts (with Blue Water-Gas Dilution).

98	102	18	218	291	75

Coke sold, 7 cwt.; tar, 10·4 gallons; sulphate of ammonia, 28 lbs.

With steamed vertical retorts, though we have been able to effect a certain saving over last year's figure on coke used for fuel, on a thermal basis the results are not so high as either of the above. The average calorific value of coals obtained from two sources, consisting of washed double nuts and coking small, is found to be 12,300 B.Th.U., and the coke is worked out at the same value. The heat content of the gas is taken at 420 B.Th.U. per c.ft., though the average is 1½ p.ct. above this. The results are as follows:

Vertical Retorts (with Steaming).

Gas.	Coke.	Tar.	Total Yield.	Coal.	Efficiency.
					P.Ct.
71	89	30	190	276	69

Coke sold, 6·5 cwt.; tar, 18 gallons; sulphate of ammonia, 42 lbs.

From a thermal-yield viewpoint, horizontal practice—and possibly the example taken is among the best available—makes very good reading; but, of course, one cannot judge the effect on the balance-sheet in this way, as the service rendered by the coke, tar, and sulphate of ammonia has to be taken into account. For the year ended May 15, 1923, further analyses show that the net cost of coal carbonized at Kirkintilloch was 6·98d. per 1000 c.ft. sold, while in my own case there was a sum at credit of 2·58d.; the net cost into holders in the first instance being 17·39d., and in the other 11·23d. It has, however, to be stated that 3·76d. of this latter figure was due to certain conditions entirely apart from the merits of the respective costs which we are to consider.

The range of declared values put forward by those undertakings who have so far come under the enactments of the Gas Regulation Act is very wide. This is not surprising. We cannot yet have what has been called a standard value. The kind of carbonizing plant, the nature of the distribution system, and the varied experiences of each undertaking in regard to the effect certain grades of gas have had on the balance-sheet, and the general service rendered to consumers in respective areas, are the deciding factors. Each gas engineer is called upon to decide for himself, not for his neighbour. The matter of real importance is to leave nothing undone to ensure the maximum efficiency from the value delivered.

The gas and electrical industries claim that they can bring gaseous fuel and electric current into the premises of the user in a form which will reduce labour, give regularity of temperature, provide convenience impossible with solid fuel, and, above all, help to rid industrial areas of a smoke-laden atmosphere. The powerful reply to the findings of the Coal Conservation Committee subscribed by Sir Dugald Clerk and Profs. Smithells and Cobb has never been seriously challenged. The case for the generation of heat energy from coal by the respective media of gaseous energy or electrical current showed that "out of every 100 heat units in the coal carbonized at good-practice gas-works, 50 are returned to the solid-fuel market as coke, 5 are recovered as tar, 22·5 are lost in manufacture and distribution, and 22·5 reach the consumer as gas." If the heat were in the form of electrical energy, the *anticipated* results for centralized production of electricity were 18 heat units (compared with the then realized result of 12 heat units) out of every 100 in the coal burned in the boilers. These figures demonstrate the strong, almost unassailable, position of the gas industry as a factor in the supply of heat energy. Yet, complacent closing of the eyes to methods which are being used to impress the community with the convenience of electric heating would result in one end only, and that an unfortunate one for the gas industry.

The Sale of Therms.

What may be called the centre of interest in gas-works practice is changing. Consideration is being given to-day to a study of the sale of heat energy, in a degree which outrivals the amount of thought displayed in recent years in its production. Improvement in the methods of efficient production will still continue; but the margin now left may not yield the same definitely satisfactory results as will concentration on measures to be adopted to deliver to the consumer the best service. Our chief heating competitor is coal of a calorific value of (say) 13,000 B.Th.U. per lb., which, burned in the average domestic fireplace with a 25 p.ct. efficiency, yields 73 therms per ton at a price of 45s., thus costing approximately 7½d. per therm. With a gas-fire of an efficiency of

70 p.ct., 1 therm will produce 70,000 B.Th.U., against the 100,000 B.Th.U. from coal, so that at this price per therm, where heat is required continuously, coal is the cheaper; but for short periods of use extending up to four to five hours, gas is undoubtedly cheaper, besides having many advantages. One unit of electricity at 100 p.ct. efficiency (allowing for no ventilation losses, taking the propaganda of electrical salesmen) produces 3440 B.Th.U. Thus, about 20 units would be used to give the heat obtainable from a gas-fire of 70 p.ct. efficiency, and the cost to the consumer would require to be 0·36d. per unit in order to compete with gas at 7½d. per therm.

Serious consideration need hardly be given to the claims of oil, though it is realized that the sale of this is not inconsiderable in isolated areas where gas and coal are dear. With the price of this at from 1s. 6d. to 1s. 8d. per gallon, gas at from 10d. to 1s. per therm will compete and give slightly more heat units, besides being altogether more convenient to use. Provided a satisfactory and reasonably cheap service of gas of constant composition is given, along with the hire of suitable appliances and the maintenance of these at a high standard of efficiency, hire sales for domestic purposes will continue to increase in ratio to the amount of energy displayed on the selling side of our business.

Industrial competition takes on a somewhat different aspect; the chief competitor in many cases being our own product coke. The efficiency in use of coke may reach as high as 80 p.ct. in certain processes; but the tendency of modern gas manufacture has resulted in the supply being inadequate to meet present needs. If the use of coal giving an over-all average efficiency of 50 p.ct., with a heat content of 12,000 B.Th.U. per lb., and costing from 27s. 6d. to 30s. per ton, were replaced by gas at economic rates, having regard to labour and maintenance costs, we should have achieved something beneficial to buyer and seller. At the lower figure named for industrial coal of the stated quality, the effective heat obtained at 50 p.ct. efficiency would cost 2·45d. per therm.

The improvement during the past three years in the design of burners has raised the efficiency factor in lighting to a remarkable extent; and efficiencies for water-boiling and heating operations are obtainable up to 85 p.ct. with any grade of gas. Unequal distribution of pressure is the chief source of complaint. Under the term distribution I include the supply of gas from the works governor to the fittings of the consumer. We all have experience of adequate main and service pressures being throttled by entirely inadequate house piping. Without remedy, conditions will get worse in this respect. The minimum pressure of 2 in. water-gauge by those undertakings coming under the prescribed pressure of the Gas Regulation Act in supplying gas of a calorific value above 350 B.Th.U. per c.ft. is a big advance on the minimum pressure of 8·10ths set down in the Burghs Gas Supply (Scotland) Act, and carries with it responsibilities which will bring satisfactory results to the supplier as well as to the user. Maintenance of consumers' appliances is now a necessity in up-to-date distribution. Good showrooms, workshops, and stores will require to be provided and be subject to efficient control, in order that still better service may be given to the public.

After the meeting the members adjourned to the Cadoro Restaurant, where the annual social gathering was held. The President occupied the chair, and was supported by Mr. J. W. M'Lusky, Mr. D. Fulton, Mr. W. B. M'Lusky, and others. After tea, there was a very enjoyable whist drive, followed by the presentation of prizes and music.

"The Story of Coal."

The miners are demanding that the Government should set up a Court of Inquiry to investigate (*a*) the relation of miners' wages at the present day to those wages in 1914, and (*b*) the relation of the increase in miners' wages since 1914 to the index figure of the increase in the cost of living. They have, however, put forward no demand that there should be an inquiry into the service that they give in return for the wages they receive. The ninth advertisement in the series "The Story of Coal," which appears elsewhere in this issue, is therefore most timely. It shows, in the clearest possible way, what is the present average production per shift of each person employed in the mines, as compared with the average production in 1914. In that production there has been a decrease of 10 p.ct. But in the wages which are paid for raising each ton that is disposable commercially there has been an increase of no less than 79·5 p.ct.—an increase fully equivalent to the increase in the cost of living. That is the real test in making a comparison between 1923 and 1914. It is a test, moreover (as the miners might do well to bear in mind) that would most certainly have to be applied if the mines were nationalized. The nation would realize that it was paying practically 80 p.ct. more money for an article, but was not getting the same quantity. The miner cannot expect to have it all three ways. If he wants shorter hours and less intensive effort, he cannot expect to get the same rate of real wages per ton of output and the sympathy of the public—who must in the long run pay the increase—on account of a decrease in the amount of his real wages per shift. We should all like to be as well off as we were in 1914, and to work less hard than we did before the war; but, unless we are in the position of monopolists, we have not been able to find anybody to employ us on these terms.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Assessment Where a Gas Undertaking Purchases in Bulk.

Sir,—The letter signed "Scrutator" which appears in your issue of yesterday's date shows a curious misapprehension of the manner in which the rateable value of gas-works is arrived at from the accounts. There is no reason in the world why the same theory should not be applied to a gas undertaking receiving its supply in bulk from a manufacturing centre elsewhere; but in the case of such an undertaking there would appear in the working expenses an item representing the price paid for the gas so purchased, which would obviously greatly exceed the rateable value of the works necessary to manufacture the gas. In this way, although the same principle is applied, the rateable value arrived at would be very much smaller.

A. L. Ryde.

49-50, *Parliament Street, S.W., April* 10, 1924

Internal Corrosion.

Sir,—At the Spring Meeting of the North British Association of Gas Managers, a paper on the new Dundee gasholder was submitted to the members. The interesting part of the discussion dealt with internal corrosion and preservatives. Internal corrosion has been exercising the minds of gas managers for some time past, not only in regard to gasholders, but also, and more particularly, in regard to meters.

In view of the importance of the subject, might I ask you to publish the paper by G. A. Schnerr on "Internal Corrosion of Gasholders" presented at the annual meeting of the New England Association of Gas Engineers, and appearing in the "American Gas Journal" for March 22.

George Keillor,
Engineer and Manager.

Corporation Gas Department, Greenock, April 8, 1924.

[The paper referred to is published on pp. 175-76 of this issue.—Ed. G.J.]

Low-Temperature Fuel Treatment in Gas-Works.

Sir,—Anyone reading my letter in your issue dated April 2, and comparing it with Mr. Rambush's reply appearing in the "Journal" for April 9, must notice that the main points of my letter are evaded. So much for Mr. Rambush's desire for strict impartiality.

Before any tenders for the Moore gas-generators at Scunthorpe were opened, I had already signed a formal agreement authorizing the Council to instal a specified number of Moore generators *free of royalties*, on certain conditions; one condition being that any contractors appointed by the Council to erect the generators *must be approved by me*. I subsequently approved of Messrs. Asbmore, Benson, Pease, & Co.'s offer being accepted, subject to the work being carried out generally in accordance with my British Patent No. 168,951, to which specification all the firms tendering had been asked to quote. A duplicate of the accepted tender and specification was lodged by me at the Ministry of Health, Whitehall, several months before I left Scunthorpe.

I have seen the two new generators recently erected at Scunthorpe, and *they are designed on the lines laid down by myself*, as specified in Messrs. Asbmore, Benson, Pease, & Co.'s tender, dated Oct. 11, 1921. If Mr. Rambush denies that they are on the lines laid down by myself, then he admits a clear breach of contract.

The design of generator illustrated on p. 769 (fig. 2) of the "Journal" is not *identical* with the Scunthorpe generators, but nevertheless it is, in my opinion, a plain infringement of Moore's British Patent No. 168,951. Therefore I am not relieved of apprehension of *an attempt* to deprive me of the fruits of my labour.

Saml. Moore.

7, *Southfield Gardens, Twickenham, April* 11, 1924.

Sir,—Having read the letters by Mr. Moore and Mr. Rambush respectively, in your issues of April 2 and 9, I think many other readers will agree with me that Mr. Rambush has failed to refute Mr. Moore's claims with regard to the new gas-generators at Scunthorpe Gas-Works.

Mr. Rambush is mistaken if he thinks that in this country the inventor of a patent ceases to be the patentee unless he personally supervises the manufacture of the patented article, or that the contractor for the erection of a patented gas-generator is justified in laying claim to the invention merely because he has fulfilled the conditions of his contract.

I believe Mr. Moore's invention has great potentialities for the gas industry.

"Anon."

April 12, 1924.

Gas Exhibition at Prescot.—The Prescot Gas Company, in co-operation with Messrs. Fletcher, Russell & Co., Ltd., and The Richmond Gas Stove and Meter Co., Ltd. (both of Radiation Ltd.) recently organized a very successful exhibition in Prescot, where considerable interest has been aroused among the 2800 consumers in the district. The exhibition ran for four days, and was well attended throughout. Conspicuous among the cookers shown were the "New World," Richmond's "Bungalow," and "Ranelagh," and Fletcher's "Kingsway" and "Household." There was a comprehensive display of all other types of gas-apparatus; the whole serving to stimulate the special cash and hire purchase schemes put into operation by the Prescot Gas Company. Cookery lectures and demonstrations were given each afternoon and evening, before an interested and appreciative audience. The exhibition was opened by Mr. W. A. Cross, one of the Directors of the Prescot Gas Company.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Co-Partnership Bill.

A Bill to promote the adoption of co-partnership by statutory and other companies was presented by Viscount Cecil of Chelswood on the 10th inst., and read the first time.

HOUSE OF COMMONS.

Gas Poisoning.

Mr. BAKER asked the President of the Board of Trade whether, in view of the continuance of fatal accidents due to the method of fixing gas-heated geysers, he would expedite the report of Mr. Butterfield on the subject; and whether, in view of the importance of the question, he will seek powers to enable him to safeguard the public.

Mr. WEBB replied that he had received a comprehensive report from Mr. Butterfield on the fatal accidents due to gas poisoning, and he proposed to publish it shortly. He hoped it would be possible to take steps to safeguard the public without recourse to legislation.

Safeguarding of Industries Act.

Mr. SIDNEY WEBB (President of the Board of Trade), replying to Mr. Remer on the 8th inst., said the Government had decided not to introduce legislation to extend the duration of the provisions of Part II. of the Safeguarding of Industries Act, which deal with the making of Orders on the ground of depreciation of foreign currency. These provisions, and the duties which had been imposed under them, would accordingly lapse on August 19 next.

HASTINGS CORPORATION BILL.

Gas Company's Objection to Rate-Aided Electricity Supply.

There was strong opposition by the Hastings and St. Leonards Gas Company to a provision in the Hastings Corporation Bill (which came before a House of Lords Committee on April 8 and 9) that deficiencies in the revenue of the Corporation electricity undertaking should be made-up out of the borough fund and borough rate. The Committee consisted of Lord Islington (Chairman), Earl Lucan, Earl Clanwilliam, Viscount Hood, and Viscount Gage.

The Corporation were represented by Mr. W. J. JEEVES, K.C., and Mr. ROWAND HARKER; and the Gas Company, by Sir HARRY COURTHOPE-MUNROE, K.C., and Mr. F. N. KEEN.

Mr. JEEVES said it was proposed to incorporate certain provisions of the Electric Lighting (Clauses) Act, 1899, in connection with the electricity undertaking, and to repeal similar provisions of the Corporation's Order of 1898, which Order empowered them to acquire the electricity undertaking. Another clause provided that all money received by the Corporation in respect of the electricity concern should be carried to the borough fund, and all payments and expenses in respect of the undertaking should be paid out of that fund. The reason for incorporating the provisions of the Electric Lighting (Clauses) Act of 1899 was that it was considered desirable that the provisions of the General Act rather than those of a Private Act should be made applicable to an undertaking. Under both the Order of 1898 and the Act of 1899, if there were any deficiency on the undertaking it had to be paid out of the rates, so that the adoption of the general law would make no difference, in this respect. The rate to which deficiencies were charged at the moment was the general district rate; but they were amalgamating all the rates, so that they would only have one, called the borough rate. This was done in the interests of economy. Receipts from the undertaking would be paid into the borough fund, and payments in respect of it would be made out of that fund. Therefore the proposals would not add a halfpenny to the burden of the ratepayers. The Gas Company were taking this opportunity to say that, notwithstanding the provisions of the general law and the Corporation's local law as existing to-day, the Corporation should not be allowed to make any deficiency, but that they should be required to charge consumers of current a sum sufficient to make the undertaking self-supporting. The Corporation had endeavoured, and intended, to do this, but it was not always possible; and it was for this reason Parliament had said that, wherever a local authority were owners of an electricity undertaking, deficiencies should be met out of the rates. As to the history of the undertaking, this showed that there had been deficiencies since 1898 amounting to £39,831, as against profits amounting to £23,267; so that the net deficiency to date was £16,563. The deficiency during the war years was £19,393; and if there had been no war, and those years had merely balanced themselves, the net result to date would have been a surplus profit of nearly £3000. In the Gas Company's petition it was submitted that the result of the working of the electricity undertaking was not such as to warrant any further powers being conferred upon the Corporation. More than £33,000 had been made good out of the rates. It was stated that the deficiency was mainly due to the fact that the charges to consumers had not been sufficient to meet manufacturing costs and interest and sinking-fund charges; and, having regard to the fact that a new generating station was being erected, which would involve further large capital expenditure and further heavy annual interest and sinking-fund charges, they viewed with alarm the proposal to make good any deficiency out of the rates. Therefore, they asked for the insertion of a clause to limit the resort which might be made to the rates. Many years ago the clause asked for by the Gas Company had been inserted in Orders, but it was unusual now.

Mr. *G. R. Butterworth*, the Borough Accountant, handed-in a table showing the results of working the undertaking, which confirmed Mr. Jeeves' figures. It also showed that the total deficiency raised by rate was £35,232, of which £2140 had been repaid. He estimated that the first year's working of the new station would result in a profit of £3000 on the undertaking at present rates, after paying all loan charges. The consent of the Electricity Commissioners to the erection of the station had been obtained, and it was expected to get the station in commission at the end of the present year. The capital cost of this extended electricity operation at Hastings was about £140,000. It was the policy of the Electricity Committee to pay off the rate aid which the undertaking had had in past years; they had limited the amount to be paid back to £2000 per annum, and the reserve fund would be gradually depleted to this extent, unless supplemented by further profits.

Cross-examining witness, Sir HARRY COURTHOPE-MUNROE ascertained that the extent of the reserve fund on March 31, 1923, was £17,000, and he pointed out that there were two reserve clauses in the Bill, which were inconsistent one with the other. Dealing with the figures of the results of working the electricity undertaking, he put it to witness that it was a fair summary of the position to say that in the 23 years from 1898 to 1921 there was almost a continuous and growing deficiency.

Witness would not agree, and pointed out that there were alternating periods of depression and profit-making, while after 1921 profits had been made. He agreed that the net amount taken from the rates up to 1923 was £33,000. Further questions brought out the fact that the Corporation estimated to lose another £7062 in 1925.

Sir HARRY suggested that this would have to be raised by rates.

Witness said it would come out of the reserve fund; £2000 would be repaid to the rates in 1925.

Mr. *Arthur Collins*, Chartered Accountant, who has advised the Corporation on the financial provisions of the Bill, gave evidence to the effect that the substitution of the composite borough rate for the general district rate could have no effect on the pockets of the Gas Company. He also made the point that under the general law a local authority not only had the right to pay any deficiency out of the rates, but were bound to do so.

In reply to the CHAIRMAN, witness said that if the Corporation had estimated to lose £7062 in 1925, they had taken a pessimistic view, having regard to the profit of £11,090 in 1923. He would not agree that the £17,000 now in the reserve fund had been collected from the rates.

Sir HARRY COURTHOPE-MUNROE, presenting the Gas Company's case, referred to the stress which had been laid by the promoters on the point that the Corporation were bound to go to the rates in the event of a deficiency being incurred on the electricity undertaking. He impressed upon the Committee that the scheme of the Corporation's Order of 1898, and the scheme of the Clauses Act of 1899, was not, as had rather been suggested, to run the undertaking at any cost and to go to the rates if they were short of money. Clearly, the intention of Parliament in giving these powers to various authorities was that they should run the undertakings at a profit, though it was necessary, of course, to make provision against possible loss. He then dealt with the trend of legislation in connection with this matter since the passing of the Clauses Act, 1899, to show that, as it had been found possible to abuse the provisions of this Act, measures had been taken by Parliament to prevent it. As early as 1902, he said, the South Metropolitan Gas Company had opposed an Electricity Order promoted by the Bermondsey Borough Council on this question, and had secured the insertion of a clause calculated to ensure that the charge made by the Borough Council for electricity should be such as would make the undertaking self-supporting. This clause was known as the "Bermondsey Clause." It was amended in 1904, when it was called the "Northumberland Clause," and again in 1911, from which date it had been known as the "Winchester Clause." A list of 42 Electricity Orders in which this clause had been inserted, in one or other of its three forms, between 1902 and 1914, was handed to the Committee; and Counsel asked that the "Winchester Clause" should be inserted in the present Bill. Obviously, he said, nothing of this kind could be done during the war period, and, so far as he knew, it had not again become a matter for discussion in Parliament until the present session. Therefore it was wrong to suggest that the policy of Parliament in 1899 was stereotyped. If he could show—as he ventured to think he had done—that there had been a constant drain on the rates, and that there had not been an honest attempt to make the undertaking self-supporting, the clause should be inserted. The Corporation estimated a loss of £7062 in 1925; and yet, since the making of that estimate, a reduction of the price of electricity had been announced.

Mr. ROWAND HARKER pointed out that the reduction referred to was taken into consideration before the estimate was arrived at.

Sir HARRY COURTHOPE-MUNROE (continuing) said that the time had come when this perpetual recourse to the rates in respect of deficiencies on electricity undertakings ought no longer to be allowed. A large number of people could not use electricity because they could not afford the cost of installation; and why in the wide world should they be penalized? It was particularly hard on the Gas Company, because they had to pay the rate-in-aid, and also to meet unfair competition.

Mr. *W. B. Keen*, Chartered Accountant, said the provisions of the Bill would have a detrimental effect on the Gas Company, because they would have to subsidize the electricity undertaking, and thereby would be required to increase the price of gas. Also, gas and electricity undertakings were assessed for local rates on a profit basis, so that if the profit of the electricity undertaking were reduced its rateable value would be reduced, and the rates paid by it would be reduced. Therefore electricity could be sold on more advantageous terms than gas, and a further burden was imposed on other ratepayers, including the Gas Company. For the year to March, 1923, the electricity undertaking paid £737 in rates, and made a profit, subject to interest and sinking fund charges, of £26,060. The rates paid were equivalent to 2·8 p.ct. of the profit. The Gas Company made a profit of £28,973, and paid in rates £2692, which was 9·3 p.ct. This condition of affairs might be made worse if the electricity undertaking were allowed to be carried on at a loss. Witness handed-in a statement dealing with the net profits or deficits of the undertaking, and the amounts charged to or transferred in aid of rates in the years from 1898 to 1923, with estimates

for 1924 and 1925. The figures to 1923 agreed with those already given by Mr. Butterworth and Mr. Jeeves; but it was shown that down to 1919 the net profits were £4263, the net deficiency £39,584, the deficiency raised by rates £35,232, and the transfer in aid of rates *nil*. The estimated net profit in 1924 was £1122, to which £878 was to be added from reserve, and the total of £2000 transferred in aid of rates; the deficiency in 1925 was estimated at £7062, with £2000 in aid of rates. If the estimates became actual fact, the undertaking would show net deficits on March 31, 1925, of £22,504, and the amount still owing to the rates would be £29,092. With regard to the suggestion that profits had been carried to the reserve fund, he said the Corporation had done nothing of the sort; what they had referred to as reserve fund was the profit and loss appropriation account. There was a clause in the Bill enabling the undertaking to raise a reserve fund by setting aside in any year a sum equal to ½ p.ct. on the aggregate amount of capital expended. This would enable them to set aside a reserve fund regardless of whether or not there was a profit, whereas the provision under the Clauses Act was that they might create a reserve fund only as an application of profits. The fund was applicable to capital purposes under the clause mentioned, so that capital expenditure could, in his view, be met out of rates. As to the £7062 which was deliberately budgeted for in 1925, this in effect meant that current was to be supplied at nearly 1d. per unit under cost. Witness complained that profits which should have been applied to the rates had not been so applied.

Mr. Rowand Harker, in cross-examination, said that the last precedent for the insertion of the "Winchester Clause" was in 1914. This matter, however, was fought out before Parliament last year, in the Worthing case, which was similar to the present one. The Worthing Gas Company had asked for the inclusion of the clause in the Worthing Corporation Bill, but the Local Legislation Committee of the House of Commons had refused. The Manager of the Hastings Gas Company was at the meeting of ratepayers at which the promotion of the present Bill was approved, and had raised no objection. Counsel challenged the statement that the proposals of the Bill would increase the price of gas, and said that in the worst year up to the present the amount paid by the Gas Company as their contribution to the deficiency was £36.

Addressing the Committee, Mr. Rowand Harker remarked that Sir Harry Courthorpe-Munroe had said that, though technically the Corporation might not be seeking new powers, they were in fact embarking upon an expenditure of money (on the new generating station) the result of which might be that they might make a bigger call on the rates even than previously. His reply was that the expenditure would have been incurred whether or not this Bill had been promoted. Permission had been obtained from the Electricity Commissioners, and the work was proceeding. They were substituting new plant for old, and the deficit anticipated in 1925 would only be incurred during the change-over. As a matter of fact, the accounts to March, 1924, had now been substantially completed, and, instead of there being a net profit of £1122, as estimated, there would be a profit of about £9000.

In reply to questions put by members of the Committee with regard to the estimated deficit in 1925, Counsel said he was willing to undertake that not a penny of the £7062 should fall on the rates.

The decision of the Committee was that the Bill be allowed to proceed.

THE NEW LAMBETH BRIDGE.

The Right to Lay Gas-Mains.

Among the many oppositions to the scheme of the London County Council for the construction of a new Lambeth Bridge over the River Thames is one by the Gas Light and Coke Company, which relates to the question of laying mains across the structure. The Bill to empower the Council to erect the bridge occupied the attention last week of a House of Lords Committee presided over by the Marquis of Bath.

Briefly, the position is that the predecessors of the Gas Light and Coke Company came to an arrangement with the predecessors of the London County Council under which the sum of £3000 was paid for what is claimed to be a perpetual right to carry gas-mains over the existing bridge, which is to be pulled down and the new one constructed in its place. Clause 19 of the Bill proposes to give the Council the sole right to determine whether gas or other mains shall, or shall not, be laid over the new bridge; and the suggestion is that the Gas Light and Coke Company should come under such a clause. If provision could be found for their mains on the new bridge, they would be asked to pay the cost of removing them from the old one, and, in addition, to bear a wayleave charge in respect of their being carried on the new bridge. The case of the Company is that, having an agreement in perpetuity for the passage of mains across the existing bridge, they are now being deprived of their rights.

There are, of course, many other oppositions to the proposals of the Bill, one of which comes from the Port of London Authority, and concerns the navigation of the river. A point raised is that the bridge would render it more difficult to navigate the large types of vessel which have to negotiate the bridges. In connection with this, several references were made to the colliers of the Wandsworth, Wimbledon, and Epsom Gas Company; and on Wednesday, April 9, while the matter was being discussed, the Wandsworth Company's largest boat, the "Mitcham," passed the Committee room on its way back from the North of England.

In the course of his remarks on behalf of the Port of London Authority, Mr. W. E. Tyldesley Jones, K.C. (who also appeared for the Gas Light and Coke Company), pointed out the great importance to the gas companies of using these large vessels. Some £50,000 a year was saved by the Wandsworth Company and the Gas Light and Coke Company by being able to transport their coal in this way. The ships of the two Companies made 558 trips up and down the river last year. Mr. Jones had intended to call evidence from the Wandsworth Company to the effect that they are at present building boats larger than the "Mitcham;" but the Chairman said he would take his word for it.

It was not until Friday, April 11, that the case for the Gas Light and Coke Company was reached. Counsel did not call evidence, but contented himself with a short address to the Committee. He refuted a suggestion which had been made—that the Council could allow the bridge to fall down and need not restore it. He held that the Council were under an obligation to maintain the bridge, and to rebuild it as often as might be necessary; and the Company had an easement at all times to maintain the two existing 18 in. mains across the bridge. It had been suggested by the Council that precedents supported the principle that they were not under an obligation to replace the mains over the new bridge; but Counsel said that all the precedents he had found pointed in an opposite direction. He asked for the insertion of a clause in the Bill placing the Council under the obligation to offer proper accommodation for the mains, and providing that the mains should be in a convenient situation, and replaced by the Council.

The decision of the Committee was that the Gas Company's existing mains should be reinstated on the new bridge, and their present facilities preserved, the cost to be borne by the County Council. The pipes were to be laid where "reasonably possible," and disputes settled by arbitration.

GREAT WESTERN RAILWAY (GENERAL POWERS) BILL.

Gas Companies' Objections.

This Bill was considered last week by a Committee of the House of Commons presided over by Major Strong Steel. Petitions were deposited against the Bill originally by the Cardiff Gas Light and Coke Company and the Holyhead and North Wales Gas and Water Corporation; but agreement was reached between the parties before it came before the Committee.

Both petitioners raised objection to proposals to alter levels of streets, &c., in connection with the carrying out of new works authorized by the Bill, on the ground that those alterations would interfere seriously with their mains and would cause damage to them. In the case of the Holyhead Gas Corporation, objection was also raised to powers being given to the Railway Company to acquire compulsorily parts of the lands on which the gas-works are situated. It was pointed out that the acquisition by them of even a small part of the gas-works site would necessitate the discontinuance of the use of the entire site for its present purpose. The Bill proposed that the intended powers of compulsory purchase should be exercised at any time within 3½ years; and if the powers were granted, the Gas Corporation could not prudently expend capital during this period on the installation of additional plant. It was anticipated that great difficulty would be experienced in finding another site for the erection of gas-works without opposition from owners of adjacent lands.

Protective clauses have now been inserted in the Bill, and have received the approval of the Committee. In the case of the Holyhead Corporation, provision is made for the exchange of other land for that required by the Railway Company. As soon as practicable after the conveyance to them of the substituted land, the Corporation are to apply to the Board of Trade for a Special Order, under the Gas Regulation Act, authorizing the erection of gas-works upon the substituted land. The expenses incurred in applying for the Order are to be met by the Railway Company, whether successful or not. If the Order is granted, gas-works are to be erected on the substituted land as soon as practicable (the plans and particulars to be submitted to, and reasonably approved by, the Railway Company) of the same capacity as the works on the land acquired by the Railway Company, and the necessary connections made with the works on the old lands of the Corporation which are not to be acquired by the Railway Company. If works of greater capacity are erected, the extra cost is to be met by the Corporation. The Corporation are to remove structures existing on the substituted lands which they will not need, and erect the necessary fences; and the Railway Company, at their own expense, if required to do so by the Gas Company, are responsible for the reasonable alteration or diversion of the sewers for the convenient laying-out of the works. As soon as the Corporation are in a position to commence the erection of the works, the Railway Company shall pay half the estimated cost; the remainder of the actual cost to be paid on completion, together with other consequential costs (if any). Interruption in the supply of gas is guarded against by a provision that the Railway Company must not use the land acquired by them until the Corporation have the new works ready for use. The Railway Company have also to pay the cost of laying mains to connect-up with existing mains. If the Railway Company intend to construct a railway, which is authorized by the Bill, across any road in which there are pipes or mains of the Corporation, one month's notice is to be given. The Corporation may alter the position of, and protect, their mains and pipes at the cost of the Railway Company. There is also provision for compensation to be paid to the Corporation for damage caused by the working of the railway to be constructed, if it does not result from neglect on the part of the Corporation. Disputes are to be settled by arbitration.

The clause for the protection of the Cardiff Gas Company provides that the Railway Company are to give 28 days' notice to the Gas Company before commencing works affecting the apparatus of the Gas Company; and, if necessary, the Gas Company may give notice to the Railway Company to alter the position of the apparatus, substitute other apparatus, or afford necessary protection, at the expense of the Railway Company, but to the reasonable satisfaction of the Engineer of the Gas Company. The Gas Company may carry out the necessary alterations themselves, at the expense of the Railway Company, if notice is given within 14 days of the receipt of the original notice. There is also power for the employment of a man by the Gas Company to watch works whereby their apparatus would be interfered with, his wages to be paid by the Railway Company; and the Railway Company are to repay the value of apparatus of the Gas Company rendered useless—such apparatus to become the property of the Railway Company. Reasonable costs incurred by the Gas Company in altering, removing, &c., apparatus by reason of the powers shall be paid by the Railway Company. Disputes are to be settled by arbitration.

MISCELLANEOUS NEWS.

GAS REGULATION ACT APPLICATIONS.

There have appeared in the "London Gazette" the following further notices regarding applications to the Board of Trade under the Gas Regulation Act.

SPECIAL ORDERS.

Ellesmere Port and Whitby Urban District Council.

Notice is given by the Council of their intention to apply for a Special Order to authorize the carrying into effect of an agreement for the acquisition by them of the undertaking of the Sutton and Hooton Gas Company, Ltd., to extend the limits of supply, to fix a differential price, to regulate the supply of gas, &c.

Emsworth Gas and Coke Company, Ltd.

The Company are applying for an Order under section 10 to enable them to acquire and utilize for gas purposes scheduled land, to issue further capital, and to make new provisions as to the supply of gas.

Mossley Corporation.

A Special Order is to be sought by the Corporation to define the limits of supply, to authorize them to purchase additional scheduled land, to borrow more money, and to make provisions regulating the supply of gas.

Newcastle-upon-Tyne and Gateshead Gas Company.

Notice is given by the Company of their intention to apply to the Board of Trade for a Special Order to provide for the transfer to them of the undertakings of the Walker and Wallsend Union Gas Company and the Chester-le-Street Gas Company, Ltd., to make provisions as to the price to be charged for gas in these areas and as to the calorific value, &c.

Watford Gas and Coke Company.

An Order under Section 10 is to be sought by the Company to confirm an agreement dated April 10 between the Company and the Rickmansworth Urban District Council for the supply of gas in bulk by the Company to the Council for a period of 21 years from Oct. 1 next, and for the provision by the Company of a high-pressure main to, and a gasholder and station meter at, the gas-works of the Council, and certain other mains, pipes, and apparatus within the limits of supply of the Council; to make further provisions in regard to stock; to increase the dividend on preference stock to be hereafter created; and to regulate the supply of gas.

DECLARATIONS OF CALORIFIC VALUE.

Hessle Gas Company.—475 B.Th.U. (June 30.)
Hoylake and West Kirby Gas and Water Company.—520 B.Th.U. (July 1.)
Leatherhead Gas and Lighting Company.—470 B.Th.U. (July 15.)
Southport Corporation.—500 B.Th.U. (April 1.)
Ware Gas Light and Coal and Coke Company, Ltd.—500 B.Th.U. (July 1.)
West Staffordshire Gas Company, Ltd.—440 B.Th.U. (May 11.)

GAS REGULATION ACT ORDERS.

We have received from the Director of Gas Administration copies of the following further Orders made by the Board of Trade under section 1 of the Gas Regulation Act.

Bridge of Allan Corporation.

The Order is in the usual terms, but with no price figure inserted. (April 10.)

New Mills Urban District Council.

After the declared date, the maximum price in respect of gas supplied by the undertakers shall be 14·4d. per therm.

After the declared date, 1·4d. per therm shall be substituted for 9d. per 1000 c.ft., 1d. per therm shall be substituted for 7d. per 1000 c.ft., 0·6d. per therm shall be substituted for 5d. per 1000 c.ft., and 0·2d. per therm shall be substituted for 3d. per 1000 c.ft. in paragraph (2) of Article I. of the New Mills Order, 1912, as amended by the proviso to that paragraph.

Prepayment meter clauses are inserted. (April 11.)

Special Orders Issued.

There were issued last week by H.M. Stationery office copies of the following further Orders as made by the Board of Trade under section 10 of the Gas Regulation Act. They can be obtained, at the cost of a few pence each, at the Stationery Office, Imperial House, Kingsway, London, W.C.2, or branches.

Bedford Gas Light Company, Brierley Hill District Gas Light Company, Eastbourne Gas Company, Melksham Gas Light and Coke Company, Ltd., Newquay (Cornwall) Gas Company, Ltd., and Uxbridge, Wycombe, and District Gas Company.

Brighton and Hove Gas Prices.—A letter was read at a meeting of the Hove Corporation from the Secretary of the Brighton and Hove General Gas Company stating that the Company have agreed with the Board of Trade that, as from Jan. 1 last a new standard price of 12d. per therm shall supersede the price of 15·2d. per therm prescribed by the Brighton and Hove Gas (Charges) Order, 1921. The arrangement is the result of the Gas Company's application to the Board of Trade for a reduction of the standard price per therm for gas from 1s. 3¼d. to 1s. 2d. per therm. The reduction in the standard does not affect the price to be charged to consumers.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

Annual Report of the Directors.

The following is the report for the year ended December 31 last, which will be submitted to the proprietors at the meeting on May 14.

The profit of the year amounted to £177,249 1s. 1d., which, together with the sum of £20,610 17s. 3d. brought forward from the previous year's account, makes a total of £197,859 18s. 4d. available for appropriation, out of which an interim dividend of 5 p.ct. (actual), less tax, amounting to £75 954 6s. 2d., was paid in November last. The Directors now recommend that, in addition to the above interim dividend, a final ordinary dividend be declared at the rate of 5 p.ct. (actual), less income-tax at 4s. 7½d. in the pound (being the average rate for the year), to be paid on May 20, making the total dividend for the year 10 p.ct., and leaving £45,951 6s. to be carried forward to the next account.

Of the agreed compromise in respect of the Association's German claims, two further instalments of 2s. 6d. in the pound on the outstanding balance have been received, and are incorporated in the accounts for 1923. The proportion of these instalments which represents realised accretion to capital, together with the undistributed balance of that account, amounts to £199 586 13s. The Directors recommend that this sum of £199,586 13s., being an accretion to capital which has been realised and turned into money, be dealt with as profit, and applied in payment of a special dividend for the year 1923 at the rate of 10 p.ct. per annum on the nominal amount of the issued capital stock of the Association, payable on the same date as the final ordinary dividend—*i.e.*, on May 20.

The total output of gas in the towns supplied by the Association in 1923 was 5198 million c.ft., showing an increase at the rate of 5 8 p.ct. on the preceding year. The number of consumers on Dec. 31 last was 241,693, and shows an increase at the rate of 2½ p.ct. in the year. The quantity of coal carbonized during the year under review was 312,845 metric tons, at an average gross cost per ton delivered on to the works of 25s. 11d., or 3s. per ton less than in the preceding year. The Droogenbosch electricity works at Brussels sold, during 1923, 16,031,129 KW.H., as compared with 11,995,096 KW.H. in 1922, an increase of 4,036,033 KW.H., or 33·6 p.ct. During the year 41 miles new gas-mains and 19 miles of new cables were laid, making the total length of mains 1378 miles, and of cables 264 miles.

At Antwerp contracts giving the Association the right to supply gas were concluded with the Communes of Loenhout (2010 inhabitants) and Brecht (4325 inhabitants) until 1957, and with Nijlen (3921 inhabitants) and Vosselaer (1630 inhabitants) until 1959. At Brussels prolongations of contract for gas and electricity were secured at Grand Bigard (1617 inhabitants) until 1946; at Waterloo (4711 inhabitants), Alsemberg (1847 inhabitants), Melsbroeck (1925 inhabitants), Sterrebeek (1877 inhabitants), and Nosseghem (1187 inhabitants) until 1954; and at Tourneppe (5696 inhabitants) and Buysighen (2786 inhabitants) until 1958. Contracts for the supply of gas and electricity were concluded with the Communes of Pamel (4036 inhabitants) and Liedekerke (5667 inhabitants) until 1963.

At Antwerp, the six vertical furnaces in the new retort-house on the Hoboken Works were put into action, and are giving complete satisfaction. At Brussels, a plot of land adjoining the Forest Works was purchased to provide additional storage room for coal, &c. The erection of a waste-heat boiler and of a fourth water-gas set at Forest was completed, and the reconstruction of the horizontal retorts at Koekelberg was continued. At the Droogenbosch central station, the two new turbo-generators—*i.e.*, one of 3750 KW. and the other of 10,000 KW.—were practically completed, and considerable progress was made with the extension of the building for the three additional boilers to be erected in 1924. Of the six new boilers mentioned in the last report, four were completed during the year under review, and the remaining two have since been taken into use. A second 10,000 KW. turbo-alternator was ordered.

The Directors who retire by rotation are Sir Charles James Jessel, Bart., Sir Henry Birchenough, Bart, K.C.M.G., and Mr. Hugh Goodwin Newton. They are eligible for re-election, and offer themselves accordingly. The Auditor who goes out of office is Mr. Theodore Brombead Bassett, who is eligible for re-election, and offers himself accordingly.

(Signed) C. J. JESSEL,
Chairman.

Bridgwater Gas Light Company.—The ordinary meeting of the Company was held on March 18—Mr. R. Y. Foley presiding. The accounts for the year ended Dec. 31 last showed that interim dividends were paid at the rate of 6 p.ct. on the "A" stock and 3½ p.ct. on the "B" and "C" stock on Oct. 1. There remained a disposable balance of £4644, from which the Directors recommended that £800 be carried to the reserve fund, and that final dividends be paid, on April 1, of 8 p.ct. on the "A" stock and 4 p.ct. on the "B" and "C" stock. This would absorb £3640, leaving a balance of £1004 to be carried to next year's accounts. During the year the sales of gas increased by 2,600,000 c.ft., and the total exceeded 100 million c.ft. The price was further reduced to 11·55d. per therm on Jan. 1 last.

Barnard Castle Gas Company.—The annual report of the Directors of this Company showed a gross profit of £1758; and after wiping out the remainder of the adverse balance incurred after the war and paying bank and debenture interests there is a clear profit of £484. Henceforward pre-war conditions will again obtain. The Directors felt that, in view of the stockholders having had no benefit for the past six years, the earliest opportunity of resuming the payment of dividends should be taken. Accordingly, they recommended the payment of a dividend for the past half-year at the rate of 4 p.ct. per annum on the original consolidated stock, and £2 17s. 1d. p.ct. per annum on the new ordinary stock, free of income-tax. This will absorb £262, and leave £224 to be carried forward. The Directors have decided to reduce the price of gas by 6d. per 1000 c.ft. (to 1s. 3·2d. per therm, or 6s. 9d. per 1000 c.ft.) as from July 1 next.

DEVON GAS ASSOCIATION, LTD.

The Eighteenth Annual Meeting of the Association was held at Exeter last week—Mr. F. Templer Depree presiding.

The Chairman, in proposing the adoption of the report, said they could look back upon an average sort of year. There had been a slight reduction in the general expenditure; but though the price of coal had been reduced, it had not come down so much as they were led to expect in the early part of the year. The revenue showed a decrease; this being due to the reduced price of gas. The increased output anticipated had hardly been realized. It was a matter of general experience that gas output in the country districts in 1923 just held its own, increases being few and far between. The prospects for the present year were, however, very encouraging. Steady increases of 10 p.ct. had been recorded for the three months already past, and there was a very keen demand for all residuals. The value of gas apparatus, irrespective of lighting, was becoming more and more generally appreciated; and in this connection he made reference to the gas exhibit at the Wembley Exhibition. He said this section of the exhibition was worthy of the heartiest support of the entire gas industry, as it was certain ultimately to benefit every gas undertaking, as it would remind consumers of the many still undeveloped advantages and uses of gas.

Mr. R. J. Rew, seconding the motion, observed that, though the past year had been a very ordinary one, the somewhat heavy recent expenditure at the works and in the district was now producing additional output and business. Everyone in close touch with gas undertakings was bound to be an optimist at the present time.

The report was adopted, and a dividend of 7½ p.ct. (less income-tax) declared.

STOCKTON GAS PROFITS AND THE RATES.

The action of the Stockton-on-Tees Corporation in taking £2000 out of gas-works profits towards the relief of local rates has aroused a storm of protest in the neighbouring districts which depend on Stockton for their gas supply.

The Thornaby Town Council voiced their feelings in the matter at a meeting on Tuesday of last week, when Stockton wrote asking if Thornaby had any objection to a draft Order containing several authorizations which it was sought to acquire. Mr. Shepherd submitted a resolution opposing the proposed Order, unless Stockton agreed that profits should be utilized for reducing the price of gas or building up to its maximum the statutory reserve fund of the undertaking. Already, he said, Stockton had taken for rate relief a considerable amount more than the total capital expenditure. This was not fair to Thornaby consumers, who were not only levied for interest and redemption on the works, but were being asked to provide a sinking fund. Thornaby was actually helping to keep down the Stockton rates. Any loss on the works would have to be borne by Thornaby, because the price of gas would then be increased to meet the loss. He could not recall the ratepayers of Stockton ever having had to provide money to help the gas-works. This had always been done by consumers, and it was only by charging an exorbitant amount for gas that the Corporation could obtain sums towards the rates in this way. Mr. Oxberry, who seconded, said Stockton were looking after themselves, which was only human nature. The fact that a profit of £12,000 was made last year proved that the charges were not reasonable. Mr. Harris suggested that a committee should be appointed to go into the whole matter; and Mr. Grimwood added that they would have to go far to find a worse system of exploitation than that for which Stockton was responsible.

The resolution was unanimously carried, and a committee were appointed.

TRADE NOTES.

Boiler-Feed Control.

Messrs. James Gordon & Co., Ltd., of Windsor House, Kingsway, W.C. 2, have prepared a booklet for the busy man. This is a description of the "Copes" system of boiler-feed control, and informs the reader what to expect of a boiler-feed regulator, and how closely those expectations may be realized. It is maintained that by the "Copes" system a smooth and continuous feed is maintained on steady loads, and that on falling loads heat is stored which becomes available when the load rises.

Suggested Electricity Supply for Liskeard.—When it was reported at the Liskeard (Cornwall) Town Council that a Plymouth firm of electrical engineers proposed to apply for a Provisional Order authorizing them to supply electricity to the Liskeard district, Councillor W. H. Huddy, who is a Director of the Liskeard Gas Company, said that his Company were prepared to instal plant and supply electric light and power to the town. The Council decided to await an official intimation from the Secretary of the Gas Company before giving their sanction to the scheme suggested from Plymouth.

Joymanco (Brighton) Ltd.—The third annual general meeting of this Company was held at the registered office, Hove, on Thursday, March 27. In moving the adoption of the report and accounts, the Chairman (Mr. H. J. Green) stated that the year had been a very successful one. There had been a considerable increase in sales, and extensions had been made of both plant and premises, to cope with the increased demand. It was proposed to pay a dividend of 10 p.ct., leaving a substantial amount to carry forward to reserve. The report and accounts were carried unanimously, as also was a vote of thanks to the Chairman, Managing Director, and staff. The shareholders, with a number of friends, joined the Directors at dinner in the evening at the Royal York Hotel, Brighton, when an enjoyable musical programme was provided.

THE NORTH-EAST COAST COAL TRADE.

From our Own Correspondent.

There is very little of interest to report from this market. The unexpectedly small majority in the ballot against the terms offered is a clear indication that at present the miners would favour a settlement by other means than a strike; but this has had little effect on the market. There is still much uncertainty as to how matters will develop, and both buyers and sellers are holding their hands. There is little or no coal available for sale for this month. Inquiry for May is good, especially from Germany; but sellers are holding for big prices in view of the labour uncertainty, and business is difficult to arrange. Holiday seasons are always well kept on the Newcastle Exchange, so that there is every prospect of matters remaining very quiet over the next week or two.

Wear Specials and best qualities of gas are quoted at 25s. 6d. to 27s., and very scarce; seconds rather less so at 23s. 9d. to 24s.

YORKSHIRE AND LANCASHIRE COAL TRADE.

From our Local Correspondent.

Although the prospects of a settlement of the colliery dispute are brighter, it is probable that the miners will take an extended holiday at Easter. Industries in Yorkshire and Lancashire have been stocking coal for some weeks, and there appears to be no great demand for the immediate future. House coals, owing to the prospect of milder weather, are not in so keen a demand, and deliveries are such as to satisfy householders during the next few weeks whether there is a stoppage or not.

Some gas concerns are rather short of fuel, and are buying spot parcels at increased prices; but the majority of these undertakings are in a safe position.

The demand for shipping coal has fallen off considerably; but probably this will be revived after the holidays, when more coal is thrown on the market from the inland section.

The advances in the price of fuel under the terms of a new arrangement with the miners is a matter of conjecture; and while some of the smaller collieries report that it may be 2s. 6d. per ton, others are inclined to view with favour a lower figure.

Nominal week-end prices at Hull were: Bunkers, Yorkshire, Derby, and Notts large screened steam, f.o.b. Humber ports, 30s. to 31s. Cargo for export, f.o.b. usual shipping ports: Best Yorkshire, hards, Association, 37s. to 38s.; Derby best hards, 35s. 6d.; South Yorkshire washed doubles, 29s. 6d.; ditto washed singles, 29s.; dry doubles, 26s. 6d.; South Yorkshire washed smalls, 23s. 6d.; Derby slack, 1 in., 18s. 3d. to 19s.; South Yorkshire rough slack, 20s.; gas coke, 41s. 6d.; foundry furnace coke, 30s. 6d. to 32s.; washed smithy peas, 30s. to 33s.; washed steam thirds, 30s.

In Lancashire prices remain considerably above the nominal colliery figures, which latter are 36s. 4d. for best house coal, 22s. 6d. for unscreened industrial coal, and 16s. to 18s. for slacks. The prices paid may be reckoned at about 2s. to 2s. 6d. above those figures.

COAL TRADE IN THE MIDLANDS.

From our Local Correspondent.

The situation has eased very perceptibly since the time of my last report. Panic buying has subsided. Demand still exceeds supply, of course, and exceptional prices are paid by industrialists in order to get quick supplies; but the general tone is more equable. The voting of the miners on the employers' offer tends to allay excitement. At the worst the crisis is relieved for the time; and except among those big consumers who cannot afford to take short views, there is a strong disposition to regard the trouble as past. Gas engineers are still pressing incessantly for increased deliveries against the arrears into which contract engagements have fallen. With transport working more satisfactorily, some little impression has been made on those arrears, but not very much. Industrial fuels are as difficult to get as ever. In some cases manufacturing production has been interfered with in consequence of supplies running out. Fancy prices are not being bid as they were a few weeks ago, however. With regard to the output of coal, some Midland collieries, in taking precautions against the possibility of a stoppage, have made such dispositions in the workings that the full quota is not being drawn.

Coke is still scarce and dear.

Vickers and International Combustion Engineering, Ltd.—Owing to rapid increase of business, and especially to provide room for the designing and estimating staff, Messrs. Vickers and International Combustion Engineering, Ltd., have removed from No. 4, Central Buildings, Westminster, to Africa House, Kingsway, W.C. 2. The telegraphic address is: "Vickomb, Westcent," and the telephone numbers Holborn 1384 and 1385.

Smoke Abatement and the Law.—The recently-formed Inter-Parliamentary Committee on Smoke Abatement waited upon Mr. Wheatley, the Minister of Health, last Thursday week, and submitted a memorandum expressing the view that public opinion was now fully prepared to accept the strengthening of the law with regard to smoke nuisances. The deputation pressed that no further time should be lost in giving legislative effect to the recommendations of the Departmental Committee on Smoke Abatement. Mr. Wheatley intimated that the Ministry of Health would at once consider how far it was possible, by encouraging and facilitating educational work in the provinces, to help forward the smoke abatement movement. They would give full and sympathetic consideration to the request of the deputation that an effort should be made to submit to Parliament a further Bill at an early date.

Gas Light and Coke Company's Assessment.

The Assessment Committee of the Marylebone Borough Council report that, at the Quinquennial Valuation of 1920, and in consequence of a considerable fall in the revenue of the Gas Light and Coke Company, the rateable value of the undertaking was reduced from £17,204 to £12,750. It being recognized, however, that the financial position of the Company might again be restored, an agreement was made with Messrs. Ryde, Son and Brown (the Surveyors for the Company) that, in the event of this taking place, no objection would be raised by either side to the insertion of the undertaking in a Provisional Valuation List, nor as to the legality of a *de novo* valuation being made on the basis of such increased revenue. It being brought to notice, therefore, that the revenue of the Company for the year 1922 was £1,520,000, as compared with £850,000 in 1919, steps were taken, in conjunction with the Rating and Valuation Committee, for the insertion of the undertaking in a Provisional Valuation List. The figure inserted in such Provisional List as rateable value was £22,800, and to this assessment the Company objected. Having had before them a complete set of figures as to the financial position of the undertaking for the year in question, and, after hearing the case for the Gas Company, the Committee fixed the rateable value of the undertaking at £16,432, or an increase of £3682 over the quinquennial figures of 1920.

Gas-Mantles and the Safeguarding of Industries Act.

The announcement of the Government that Part II. of the Safeguarding of Industries Act is to be allowed to lapse in August is, says the "Times," viewed with dismay by the several industries which have benefited from Orders made under it. Referring to the gas mantle industry, the "Times" says: "Manufacturers of incandescent mantles believe that the removal of the duties will bring their work to a standstill. At present there are six factories, at which over 2000 persons are employed. Thus the industry is a small one, but it has already grown with the help of the duty and is capable of still further expansion if cheap German goods are kept off the market. It would be a pity for this branch of manufacture to be killed, for it has overcome the pre-war handicap involved in the fact that Germany controlled the two principal raw materials. Mr. A. D. Metcalfe, a Director of Lighting Trades, Ltd., said: 'Since the duty was put on we have found we can compete with Germany, though large quantities of German mantles are still coming into the country. The German prices are a little below ours, but the difference is not big enough to stop dealers from buying our product. If the duty is taken off we shall not be able to get any orders in competition with the Germans. Probably we shall have to close our factories and buy from Germany in order to keep our trade. We shall become largely an importing firm instead of a manufacturing concern. We ask for protection only so long as the German competition, owing to depreciated currency and bad wages, is unfair. Given equal conditions, the British product can hold its own both as to quality and price.'"

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *April* 14.

In the London market pitch continues in an uninteresting state, and no business is reported. The price is purely nominal. For next season's delivery a certain amount of interest is being taken in the neighbourhood of 70s. per ton f.o.b. makers' works. Creosote is a somewhat quiet market, the price being about 9d. per gallon net. Naked solvent naphtha 95-160 is firm at about 1s. 7d. per gallon, pure toluole about 1s. 10½d. per gallon, and pure benzole about 1s. 9d. per gallon. Other products are without change.

Tar Products in the Provinces.

April 14.

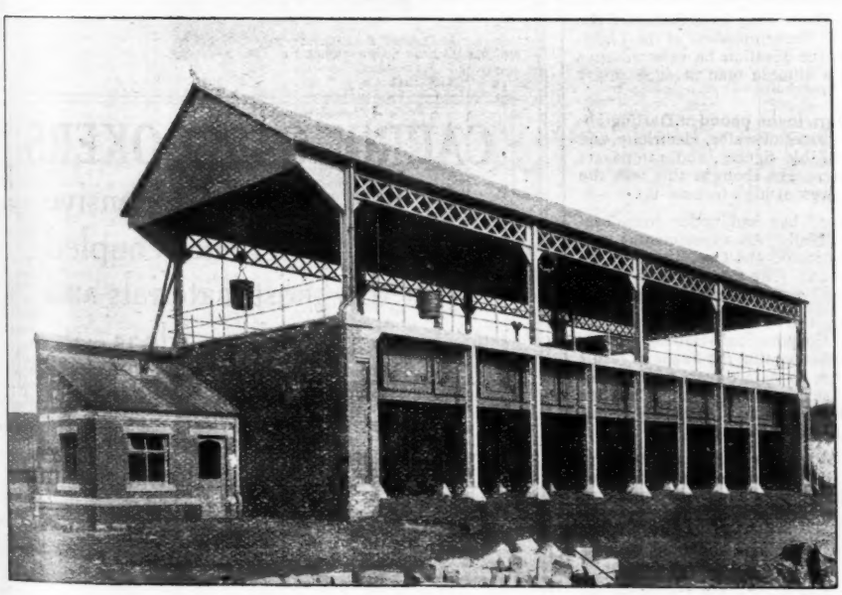
The market for pitch has been quiet throughout the past week; but there appears to be more inquiry for forward delivery, which at present makers are not interested in—believing that higher prices will rule for Autumn shipment later on. Creosote oil continues very quiet, and there is little or no demand at present. Carbolic acid remains firm, but with no alteration in price. Cresylic acid is still dull. Naphthalene is quiet for all qualities.

The average values for gas-works products during last week were: Gas-works coal tar, 48s. 6d. to 53s. 6d. Pitch, East Coast, 55s. to 57s. 6d. f.o.b. West Coast—Manchester, 51s. 6d. to 52s. 6d; Liverpool, 52s. 6d. to 53s. 6d.; Clyde, 54s. to 55s. Benzole 90 p.ct., North, 1s. 5d. to 1s. 6d.; crude 65 p.ct. at 120° C., 1s. to 1s. 1d. naked at makers' works; 50-90 p.ct., naked, North, 1s. 8d. to 1s. 10d. Toluole, naked, North, 1s. 5d. to 1s. 6d., nominal. Coal tar crude naphtha in bulk, North, 7½d. to 8d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 5d. Heavy naphtha, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, liquid, 7⅛d. to 7⅜d.; salty, 7¼d. to 7⅜d.; Scotland, 7d. to 7½d. Heavy oils, in bulk, North, 9d. to 9¼d. Carbolic acid, 60 p.ct., 2s. 1¼d. to 2s. 4½d. prompt. Naphthalene, £15 to £16; salts, £6 to £8, bags included. Anthracene, "A" quality, 4d. per minimum 40 p.ct., purely nominal; "B" unsaleable.

Manchester District Tar Prices.

Our correspondent for tar prices from the Manchester district writes: The average price realized for the sale of tar, according to the sliding-scale, for the month of January, was £3 18s. 8·95d.

Gas to be Cheaper at Salford.—It is proposed by the Salford Gas Committee that a reduction shall be made in the price of gas, to take effect from July 1 of 4d. per 1000 c.ft. (from 3s. 10d. to 3s. 6d.), to domestic consumers within the borough.



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MANCHESTER.

Alnwick Gas Price Reduction.—The Directors of the Alnwick Gas Company announce a reduction in the price of gas to ordinary meter consumers of 0·6d. per therm (3d. per 1000 c.ft.), as from the March quarter readings.

Anti-Waste Appliances.—A Company has been formed bearing this name, with a capital of £100, to carry on business as makers of gas and coal stoves and other domestic appliances. The office is at No. 16, Pall Mall, S.W.

New Holder for Middlesbrough.—The Consulting Engineer (Mr. W. Doig Gibb) has reported to the Middlesbrough Gas Committee approving of the site for the erection of a proposed holder and tank, and recommending (1) a spirally-guided holder in preference to a guide-framed one; (2) a piled and disc foundation of reinforced concrete; (3) a steel tank above ground; (4) a four-lift holder; (5) a "floating" gasholder crown (untrussed); and (6) a steel superstruction to support the crown when the holder is empty. The scheme is to be proceeded with in accordance with these recommendations.

Fire at Messrs. J. & W. B. Smith's London Premises.—Part of the warehouses and stock of J. & W. B. Smith, Limited, gas fittings, &c., manufacturers, at Farringdon Road, E.C., were seriously damaged by fire last Thursday morning. Owing to the efforts of 100 firemen, with sixteen fire engines, the outbreak was confined to Nos. 21 to 23, Farringdon Road, and was subdued in a couple of hours. Mr. Watkinson, the General Manager, estimates the value of the building at £10,000; while about £25,000 worth of stock was destroyed. Their premises Nos. 15, 17, and 19, Farringdon Road, including the showrooms, offices, &c., are not affected; and the firm have other warehouse accommodation and sufficient stock on hand to enable them to carry on business as usual.

The Uttoxeter Urban Council have decided to oppose the Uttoxeter Gas Company's new Order, as they consider the standard rate of 1s. 1d. per therm asked for too high.

The Doncaster Gas Committee recommend a reduction in the price of gas by ½d. per therm, to date from April 1 for ordinary consumers; the price wheels of prepayment meters to be altered as near that date as practicable.

The Oswaldtwistle Gas Committee have completed the purchase of buildings which they intend to convert into showroom, stores, and workrooms, to popularize the use of gas for cooking, heating, and other purposes.

While working at the Gas Light and Coke Company's headquarters in Horseferry Road, Westminster, John Moorhouse, a carpenter, employed by a firm of contractors, fell through a trap-door from the ground floor to the basement. He died from his injuries on the way to hospital.

The Town Clerk of Middlesbrough was authorized last week to apply to the Unemployment Grants Committee for a grant of 60 p.ct. of the wages bill in connection with a list of nine streets in which duplicate gas-mains could be laid by unemployed labour during the spring and summer.

The Oldham Corporation Lighting Committee have discussed the desirability of appointing an independent Superintendent of the Lighting Department, and have resolved that the question be referred to a Sub-Committee, with power to appoint a suitable man at such salary as they may deem reasonable.

In moving the adoption of a rate of 9s. in the pound at Darlington, Alderman W. E. Pease, M.P., said the prices of water, electricity, and gas had been reduced to the lowest possible figures, and ratepayers were getting the advantage in this way. He thought this was the proper thing to do, especially with the present high income-tax.

The Tavistock Urban District Council has had under consideration the question of heating the Town Hall. An experimental gas-radiator was fixed in the hall, and impressed the Committee by its efficiency, cheapness, and ease of operation. The Council have therefore decided to invite tenders for an installation consisting of eight ten-loop radiators.

A rough statement on the Bradford Corporation's trading department during the year ended March 31 indicates that the financial result of the Gas Department may be even better than last year, when there was a gross profit of £97,604, and a net surplus of £25,301. Coal has been dearer, and the income from residuals considerably reduced; but there has been a fall in wages and cost of other materials.

The annual report of the Blyth Borough Surveyor states that the number of public street-lamps lighted this season is 962. Of these, 797 are controlled by Messrs. Alder and Mackay's two-wave pressure apparatus, 33 by the Gas-Meter Company's clock controllers, and 132 by the Metropolitan Gas-Meters' patent. The estimated saving made by lighting the lamps automatically is approximately £800 for the season.

Mr. H. D. Madden recently lectured to the Cardiff Rotarians on "The Gas Industry and Public Service." He said the original gas-works of Cardiff occupied an acre-and-a-half site in Bute Terrace, where the Company's offices are now situated. The works at Grangetown are on a site of 40 acres. In the process of the conversion of the coal into its component parts, 75 p.ct. of the total heat of the original coal was available for use in the shape of gas, coke, tar, &c. Mr. Madden illustrated the progress from hand shovels in stoking to vertical retorts. The conservation of waste heat was, he said, being studied. The industry had fully realized that the magnitude of the processes of gas making, coke production, and tar treatment were scientific, requiring the services of technically-trained men. The public service of gas supply had done a very great work towards cleansing the atmosphere. In the district supplied by the Cardiff Company about 50,000 gas-cookers were in use, displacing the use of raw coal. The hours of peak load supply occurred between 11 a.m. and 1 p.m. on Sundays for cooking, and this load was greatest in the summer months.

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STOCK MARKET REPORT.

It is satisfactory to note that the Experts' reports on Germany's financial affairs have been generally approved, and the swift decision of the Reparations Commission to adopt their conclusions subject to hearing the German delegates created a hopeful impression that a solution of this very difficult problem is now at hand. It remains to be seen, however, whether it will be possible for the interested parties, after examination of the details, to agree to the various recommendations. Apparently the reports have had no effect on the Stock Exchanges, and the home political conditions have not during the week been conducive to settled markets.

On Monday there was a continuance of the strong tone of the previous week, although dealings were on the small scale; but the defeats of the Government brought into renewed prominence the uncertainty of home affairs, while the decision of General Smuts to dissolve the present South African Government was also an unsettling influence.

Very quiet conditions prevailed in the Industrial Market. Iron, Coal, and Steel shares were generally lower. There are signs of activity in the business of motor companies; but the justifiable claim for increased wages from the engineers discounts the hope of any material improvement. Oils were well supported and Lobitos, on rumours of an increased dividend, broke all records by advancing to 9⅜. Other companies benefited in sympathy.

Gas stocks and shares were steady during the whole week, and it is interesting to note that all the changes in the quotations were on the upward grade. Croydon sliding-scale rose 2 points, to 101-104; Gas Light ordinary ½, to 90½-92½; Imperial Continental 2, to 145-150; Oriental 1, to 98-103; San Paulo 5 p.ct. debenture ½, to 39-41; South Suburban 5 p.ct., 1 to 97-100; and Wandsworth (Wimbledon 5 p.ct.) 3, to 108-113. On the Home Exchange Tynemouth rose 2 points, to 86-88.

The following transactions were recorded during the week: On Monday, Alliance and Dublin 69 *ex* div., Bournemouth 4 p.ct. debenture 79⅜, Brentford "B" 99, 99½, 4 p.ct. debenture 80, Brighton and Hove original 172½, British 119, Cape Town 7½, Commercial 4 p.ct. 91, 91⅜, 92½, 3⅛ p.ct. 91, 3 p.ct. debenture 58½, 59½, 60, Croydon sliding-scale 103, 103½, European 7, 7½, 7⅜, Gas Light and Coke 90, 90⅜, 90⅜, 91, 91½, 91½, 3⅛ p.ct. maximum 62, 4 p.ct. preference 78⅜, Montevideo 55, Primitiva 8s., 8s. 6d., 5 p.ct. preference 33s., 33s. 6d., South Metropolitan 97, 3 p.ct. debenture 59½. On Tuesday, Brentford "B" 99½, 5 p.ct. preference 91, Continental Union 28, Croydon maximum dividend 85, 85½, European 7, Gas Light and Coke 90½, 90⅜, 90¾, 91, 91⅛, 91⅜, 4 p.ct. preference 78, 78½, Imperial Continental 146, Liverpool 7 p.ct. preference 105, Oriental 101½, Primitiva 8s. 1½d., 5 p.ct. preference 33s., South Metropolitan 97½, 97½. Supplementary prices, Gas Light and Coke 10 p.ct. bonds 192½. On Wednesday, Bournemouth "B" 12, 12½, 12⅜, Brentford "B" 98½, 99, 99½, British 7 p.ct. preference 122½, Continental Union 29½, Gas Light and Coke 90⅜, 90⅞, 91, 91½, 91⅜, 3⅛ p.ct. maximum 61½, 62, 62⅜, 4 p.ct. preference 78½, 78⅜, 79, 79½, 80, 3 p.ct. debenture 59½, Hastings and St. Leonards 3½ p.ct. 80, Imperial Continental 147, 148, Oriental 102½, Primitiva 8s., 8s. 1½d., 5 p.ct. preference 53s. 6d., South Africa 8½, 8½, South Metropolitan 98, South Suburban 5 p.ct. 99, 99⅜, Southampton 5 p.ct. maximum 88. Supplementary prices, Newport (Mon.) 5 p.ct. maximum 81, 81½. On Thursday, Bombay 5⅜, Bristol 5 p.ct. maximum 90½, Commercial 3½ p.ct. 91⅛, Continental Union 28½, European 7⅛, Gas Light and Coke 90⅜, 90⅞, 91½, 91⅜, 91⅜, 4 p.ct. preference 78⅜, 3 p.ct. debenture 60, Imperial Continental 147, 148, South Metropolitan 97, 97½, South Suburban 5 p.ct. 99, 99⅜, Southampton 5 p.ct. maximum 88, 88½, Tottenham "B" 99. Supplementary prices, Wandsworth 5 p.ct. preference 95. On Friday, Brentford "A" 99, "B" 99, European 7, 7½, Gas Light and Coke 91, 91½, 91½, 91⅜, 92, 4 p.ct. preference 79½, 3 p.ct. debenture 61, Imperial Continental 146½, 148, 3½ p.ct. debenture 70, Montevideo 56½, 57, Primitiva 8s. 1½d., 5 p.ct. preference 33s. 6d., 4 p.ct. (B. Ayres) debenture 55½, South Metropolitan 96⅜, 97½, 3 p.ct. debenture 59½.

There were some extreme fluctuations in the Money Market. A superabundant supply of money early in the week was followed by stringent conditions on Wednesday, and both loans and discount advanced. A small amount was borrowed from the Bank of England at 4½ p.ct., and 3½ p.ct. was paid for overnight accommodation. A reaction occurred on Friday and at the close of the day lenders accepted 1 p.ct. for surplus balances. Treasury Bills were allotted at £3 0s. 5·84d. p.ct. The dollar-sterling improved slightly in favour of sterling and closed at 4.32½. The French franc moved moved against us, and closed at 73.25. Belgians left off at 86⅜.

Silver was more active. The Continent and China were buying and the cash price rose to 33 1/16.

The Bank rate is 4 p.ct., to which it was raised from 3 p.ct. on July 5.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S TRANSACTIONS.

Issue.	Share.	When ex-Dividend.	Ante-War Dividend & Bonus.	Last Divid. at Rate of	NAME.	Closing Prices, July 30 1914.	Variation. Quotations, April 11.	Variation. Lowest and Highest Prices of Transactions.
£			p.c.	% p.a.				
131,978	Stk.	Feb. 7	—	5	Aldershot 5 p.c. max. C.	..	70—75	...
335,492	,,	,,	4	4	Do. 4 p.c. Pref.	..	68—73	...
1,531,868	,,	Apl. 3	2½	6	Alliance & Dublin Ord.	59—64	64—69*	69
374,000	,,	Jan. 10	4	4	Do. 4 p.c. Deb.	76—79	00—65	...
180,000	5	Oct. 18	7½	8	Bombay, Ltd.	..	5—5⅜	5⅜
100,000	10	Mar. 6	—	8½	Bournemouth Gas & Water { 5 p.c.	..	12⅜—13⅛	...
					B 7 p.c.	13—15½	11⅜—12½	12—12⅜
983,110	10	,,	7	7	Pref. 6 p.c.	13½—14	11—12	...
115,000	10	,,	6	6	4 p.c. Deb.	..	75—80	79⅛
162,025	—	Dec. 28	—	4	Brentford A Consolid.	..	96—101	99
992,045	Stk.	Feb. 21	—	6⅚	Do. B New	..	96—101	98⅛—99½
999,500	,,	,,	—	6½	Do. 5 p.c. Pref.	109—111	89—94	91
75,000	,,	,,	5	5	Do. 4 p.c. Deb.	91—93	76—81	80
306,690	,,	Dec. 13	4	4	Brighton & Hove Orig.	208—213	170—175	172½
214,740	,,	Mar. 6	11	11½	Do. A Ord. Stk.	154—159	124—127	...
244,200	,,	,,	8	8½	Bristol 5 p.c. max.	..	90—91⅜	90½
1,287,500	Stk.	Feb. 21	—	5	British Ord.	..	117—121	119
855,000	,,	Mar. 20	—	7	Do. 7 p.c. Pref.	..	120—125	122½
100,000	,,	—	—	7	Do. 4 p.c. Deb. Stk.	88—90	73—78	...
120,000	,,	Dec. 28	4	4	Cape Town & Dis., Ltd.	1⅛—2⅛	6⅞—7⅛	7⅛
100,000	10	,,	—	6	Do. 4½ p.c. Pref.	4—6	6—7	...
100,000	10	Oct. 31	—	4½	Do. 4½ p.c. Deb. Stk.	70—75	73—78	...
150,000	Stk.	Dec. 28	4½	4½	Cardiff 7½ p.c. Deb.	..	105—110	...
237,860	,,	,,	—	7½	Chester 5 p.c. Ord.	108—110	85—90b	...
157,150	,,	Mar. 6	5	6½	Commercial 4 p.c. Stk.	106—108	90—95	91—92½
1,513,280	,,	,,	5/9/4	6	Do. 3½ p.c. do.	103—105	90—95	91—91⅜
560,000	,,	,,	5⅛	6	Do. 5 p.c. Deb. Stk.	69½—71½	56—60	58½—60
475,000	,,	Dec. 13	3	3	Continental Union, Ltd.	26—29	28—33	28—29½
800,000	,,	14 Jan. 15	4	—	Do. 7 p.c. Pref.	115—118	75—80	...
200,000	,,	Dec. 13	7	7	Croydon sliding scale.	..	101—104	103—103½
660,000		Mar. 6	—	6½	Do. max. div.	..	83—86	85—85⅛
284,075	,,	,,	—	5	Derby Con. Stk.	125—135	108—110c	...
492,270	Stk.	Feb. 21	6	4½	Do. Deb. Stk.	102—104	74—76c	...
55,000	,,	Jan. 12	4	4	East Hull 5 p.c. max.	..	..	..
209,000	,,	Apl. 3	—	5	European, Ltd.	17½—18	7—8	7—7⅛
1,002,180	10	Jan. 24	10	2	Gas Light and Coke { 4 p.c. Ord.	98—102	90½—9	90—92
16,503,045	Stk.	Feb. 7	4/17/4	5½	3½ p.c. max.	76—79	60—63	6 ½—62½
1,000,000	,,	,,	3½	3½	4 p.c. Con. Pref.	96—99	77—80	78—80
4,062,235	,,	,,	4	4	3 p.c. Con. Deb.	72½—74½	58—61	55½—61
4,761,930	,,	Dec. 13	3	3	10 p.c. Bonds	—	..	19 ½
130,000	,,	Dec. 11	10	10	7½ p.c. Ilford Deb.	..	..	...
42,000	—	—	—	7½	Hastings & St. L. 5 p.c.	..	91—96	...
82,500	,,	Mar. 20	5	6⅔	Do. 3½ p.c.	87—89	76—81	80
258,740	,,	,,	3½	5⅛	Hongkong & China, Ltd.	16½—16⅝	16—17	...
70,000	10	Oct. 18	11	10	Hornsey 7 p.c.	..	143—148	...
86,600	Stk.	Mar. 6	9	10	Imperial Continental	150—160	145—150	145—148
1,476,000	,,	Nov. 15	9	5	Do. 3½ p.c. Deb. Red.	84—86	69—72	70
401,400	,,	Feb. 7	3½	3½	Lea Bridge Ord. 5 p.c.	119—121	92—97	...
235,242	,,	Mar. 6	6½	6½	Liverpool 5 p.c. Ord.	..	89—90b	...
2,227,340	,,	Feb. 21	—	5⅛	,, 7 p.c. Pref.	..	103½—106½b*	105
600,000	,,	Mar. 20	—	7	Maidstone 5 p.c.	..	124—129	...
165,736	,,	Feb. 21	7/5/6	8	Do. 3 p.c. Deb	..	54—59	...
63,480	,,	Dec. 28	—	3	Malta & Mediterranean Met. of Melbourne { 4½ p.c. Deb.	4⅛—4⅜	3⅛—3⅜	...
75,000	5	Dec. 13	6	5		99—101	93—96*	...
50,000	100	Apl. 1	4½	4½	Montevideo, Ltd.	..	54—59	57—57
541,920	Stk.	Nov. 29	4	4	Newcastle & Gatsh'dCon.	98½—99½	83—86d	...
1,875,892	,,	Mar. 6	4½	5½	Do. 4 p.c. Pref. Stk.	..	73—75d	...
250,166	,,	,,	—	4	Do. 3½ p.c. Deb.	82—83	71—73d	...
349,705	,,	Dec. 28	3½	3½	North Middlesex 10 p.c.	—	16—17	...
15,000	10	Mar. 6	—	11	,, 7 p.c.	14—15	11⅛—11⅝	...
75,940	10	,,	7/14/0	7/10	Oriental, Ltd.	117—122	98—103	101½—102½
300,000	Stk.	Nov. 29	8	9	Plym'th & Stonh'se 5 p.c.	—	107—112	...
138,120	Stk.	Dec. 28	—	7⅞	Portsea Island, B	128—131	102—105	...
60,000	50	Mar. 6	13	13	Do. C	118—121	98—103	...
100,000	50	,,	12	12	Primitiva Ord.	5⅛—6	⅞—1	8/—8/6
1,450,345	5	29 Oct. 14	8	—	Do. 5 p.c. Pref.	4⅞—5	1⅛—1⅜	33/—33/6
2,499,800	5	30 Dec. 15	5	—	Do. 4 p.c. Deb.	91—93	70—75	...
341,400	100	Dec. 3	4	4	Do. Aires ,, 1911	—	54—57	...
600,000	Stk.	Jan. 24	4	4	Do. B. Aires 4 p.c. Deb.	85—87	55—58	55⅛
220,335	,,	Dec. 28	4	4	Do. Riv. Pl. 4 p.c. Deb.	85—87	55—58	...
321,670	,,	,,	4	4	San Paulo { 6 p.c. Pref.	10½—11	5⅛—6	...
150,000	10	Oct. 4	6	6	5 p.c. Deb.	47—49	39—41	...
125,000	50	Jan. 2	5	5	Sheffield A	..	99—101e*	...
270,000	Stk.	Mar. 20	—	5/8/4	Do. B	..	99—101e*	...
419,968	,,	,,	—	5/8/4	Do. C	..	99—101e*	...
1,047,000	,,	,,	—	5/8/4	Shrewsbury 5 p.c.	—	..	...
133,201	Stk.	—	—	6	South African	10½—11½	7—9	8⅛—8½
90,000	10	Oct. 18	9	6	South Met. Ord.	111—113	96—98	96½—98
6,609,895	Stk.	Feb. 21	5/9/4	6½	Do. Red. Pref.	—	98—100	...
102,580	,,	Jan. 10	—	5	Do. 3 p.c. Deb.	72½—74½	57—60	59½
1,895,445	,,	,,	5	5	Do. 6½ p.c. Deb.	..	103—105	...
734,000	,,	Mar. 6	—	6½	South Shields Con. Stk.	137—139	136—138d	...
92,500	,,	Aug. 23	8½	8½	S'th Suburb'n Ord. 5 p.c.	114—116	97—100	99—99½
1,087,795	,,	Feb. 21	6	6⅓	Do. 5 p.c. Deb. Stk.	116—118	95—100	...
368,837	,,	Dec. 28	5	5	S'th'mpt'n Ord. 5 p.c. max	99—102	86—89	88—88½
647,740	,,	Nov. 15	5	6	Do. 4 p.c. Deb. Stk.	..	74—79	...
121,275	,,	Dec. 28	4	4	Swansea 7 p.c. Pref. Stk.	..	100—102	...
250,000	,,	Mar. 6	—	7	Do. 6½ p.c. Deb. Stk.	..	102—104	...
200,000	,,	Dec. 28	—	6½	Tottenham { A 5 p.c.	135—138	119—124	...
120,000	,,	Feb. 21	—	8	B 3½ p.c.	115—117	98—103	99
882,275	,,	,,	6	6½	District { 4 p.c. Deb.	87—89	77—81	...
181,255	,,	Dec. 13	4	4	Tynemouth Con. & New	104½—109	86—88d*	...
258,251	Stk.	Mar. 20	1	7/14/4	Wandsworth, Wimbledon, and Epsom—			
30,000	,,	Mar. 6	8½	9½	Wandsworth A 5 p.c.	151—156	132—137	...
255,636	,,	,,	6½	7½	Do. B 3½ p.c.	129—134	110—115	...
108,075	,,	,,	6½	7½	Do. C ,,	110—115	96—101	...
240,865	,,	,,	5/17/3	6/7/9	New Ordinary	..	..	...
132,000	,,	,,	—	6/7/9	Wimbledon 5 p.c.	117—122	108—113	...
98,000	,,	,,	6½	7½	Epsom ,, p.c.	121—126	112—117	...
88,426	,,	Dec. 28	3	3	3 p.c Deb. Stk.	66—69	56—61	...

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